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APPENDIX A

A. Melt Flow Index of Blended Recycled Polyethylene Resins.

Table A.1 MFI $_{2.16\text{ kg}/190^\circ\text{C}}$ of Blended Recycled Polyethylenes Resins.

Sample Code	MFI $_{2.16\text{ kg}/190^\circ\text{C}}$ (g/10 min)			Data	X	SD	% Variation
	1 st	2 nd	3 rd				
Virgin HDPE	0.06	0.06	0.07	3	0.06	0.01	9.12
Recycled HDPE (film)	0.06	0.05	0.06	3	0.06	0.01	10.19
Recycled HDPE (bottle)	2.46	2.52	2.52	3	2.50	0.03	1.39
Recycled LDPE	4.26	4.26	4.38	3	4.30	0.07	1.61
F 1	0.19	0.16	0.17	3	0.17	0.02	8.81
F 2	0.16	0.16	0.15	3	0.16	0.01	3.69
F 3	0.26	0.23	0.24	3	0.24	0.02	6.28
F 4	0.18	0.18	0.19	3	0.18	0.01	3.15
F 5	0.29	0.28	0.28	3	0.28	0.01	2.04
F 6	0.43	0.44	0.43	3	0.43	0.01	1.33
F 7	0.28	0.29	0.29	3	0.29	0.01	2.01
F 8	0.48	0.48	0.47	3	0.48	0.01	1.21
F 9	0.48	0.47	0.47	3	0.47	0.01	1.22
F 10	0.16	0.15	0.15	3	0.15	0.01	3.77
F 11	0.12	0.13	0.13	3	0.13	0.01	4.56
F 12	0.19	0.19	0.18	3	0.19	0.01	3.09
F 13	0.13	0.12	0.12	3	0.12	0.01	4.68
F 14	0.17	0.18	0.18	3	0.18	0.01	3.27
F 15	0.34	0.30	0.32	3	0.32	0.02	6.25
F 16	0.21	0.19	0.20	3	0.20	0.01	5.00
F 17	0.33	0.30	0.31	3	0.31	0.02	4.88
F 18	0.31	0.29	0.30	3	0.30	0.01	3.33
F 19	0.06	0.07	0.07	3	0.07	0.01	8.66
F 20	0.06	0.07	0.07	3	0.07	0.01	8.66
F 21	0.13	0.14	0.14	3	0.14	0.01	4.22
F 22	0.09	0.07	0.08	3	0.08	0.01	12.50
F 23	0.15	0.16	0.16	3	0.16	0.01	3.69
F 24	0.22	0.20	0.21	3	0.21	0.01	4.76
F 25	0.04	0.05	0.05	3	0.05	0.01	12.37
F 26	0.18	0.19	0.19	3	0.19	0.01	3.09
F 27	0.19	0.18	0.18	3	0.18	0.01	3.15

Table A.2 MFI $_{5\text{ kg}/190\text{ }^{\circ}\text{C}}$ of Blended Recycled Polyethylenes Resins

Sample Code	MFI $_{5\text{ kg}/190\text{ }^{\circ}\text{C}}$ (g/10 min)			Data	X	SD	% Variation
	1 st	2 nd	3 rd				
Virgin HDPE	0.26	0.28	0.26	3	0.27	0.01	4.33
Recycled HDPE (film)	0.15	0.14	0.13	3	0.14	0.01	7.14
Recycled HDPE (bottle)	13.14	13.26	13.26	3	13.22	0.07	0.52
Recycled LDPE	18.42	18.54	18.48	3	18.48	0.06	0.32
F 1	0.82	0.82	0.81	3	0.82	0.01	0.71
F 2	0.79	0.78	0.78	3	0.78	0.01	0.74
F 3	1.11	1.07	1.09	3	1.09	0.02	1.83
F 4	0.83	0.84	0.84	3	0.84	0.01	0.69
F 5	1.33	1.34	1.34	3	1.34	0.01	0.43
F 6	2.15	2.13	2.12	3	2.13	0.02	0.72
F 7	1.21	1.21	1.20	3	1.21	0.01	0.48
F 8	2.10	2.18	2.16	3	2.15	0.04	1.94
F 9	2.08	2.08	2.06	3	2.07	0.01	0.56
F 10	0.54	0.56	0.55	3	0.55	0.01	1.82
F 11	0.56	0.59	0.57	3	0.57	0.02	2.66
F 12	0.87	0.90	0.89	3	0.89	0.02	1.72
F 13	0.57	0.56	0.56	3	0.56	0.01	1.02
F 14	0.88	0.87	0.87	3	0.87	0.01	0.66
F 15	1.39	1.40	1.40	3	1.40	0.01	0.41
F 16	0.88	0.92	0.91	3	0.90	0.02	2.30
F 17	1.33	1.37	1.34	3	1.35	0.02	1.55
F 18	1.39	1.40	1.40	3	1.40	0.01	0.41
F 19	0.40	0.39	0.39	3	0.39	0.01	1.47
F 20	0.37	0.39	0.39	3	0.38	0.01	3.01
F 21	0.60	0.61	0.60	3	0.60	0.01	0.96
F 22	0.35	0.35	0.34	3	0.35	0.01	1.67
F 23	0.62	0.58	0.59	3	0.60	0.02	3.49
F 24	0.91	0.96	0.95	3	0.94	0.03	2.81
F 25	0.60	0.61	0.60	3	0.60	0.01	0.96
F 26	0.91	0.97	0.96	3	0.95	0.03	3.40
F 27	0.92	0.97	0.95	3	0.95	0.03	2.66

APPENDIX B

B. Analysis of Variance (ANOVA) Table of Melt Flow Index.

B.1 One-way ANOVA Table of MFI _{2.16g/190°C}

ANOVA Table B.1 for MFI 2.16 by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	.238792	7	.0341131	5.26	.16
Within groups	.129733	20	.00648667		
Total (Corr.)	.368525	27			

The StatAdvisor

The ANOVA table decomposes the variance of MFI 2.16 into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 5.25896, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean MFI 2.16 from one level of Virgin HDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table B.2 for MFI 2.16 by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	.000451852	2	.000225926	.2	.9844
Within groups	.345511	24	.0143963		
Total (Corr.)	.345963	26			

The StatAdvisor

The ANOVA table decomposes the variance of MFI 2.16 into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .0156933, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean MFI 2.16 from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table B.3 for MFI 2.16 by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	.177896	2	.0889481	12.70	. 2
Within groups	.168067	24	.00700278		
Total (Corr.)	.345963	26			

The StatAdvisor

The ANOVA table decomposes the variance of MFI 2.16 into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 12.7018, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean MFI 2.16 from one level of Recycled HDPE bottle to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table B.4 for MFI 2.16 by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	.133519	2	.0667593	7.54	. 29
Within groups	.212444	24	.00885185		
Total (Corr.)	.345963	26			

The StatAdvisor

The ANOVA table decomposes the variance of MFI 2.16 into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 7.54184, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean MFI 2.16 from one level of Recycled LDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

B.2 One-way ANOVA Table of MFI _{5kg/190°C}

ANOVA Table B.5 for MFI 5 by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	4.78188	7	.683126	5.55	.12
Within groups	2.46024	20	.123012		
Total (Corr.)	7.24212	27			

The StatAdvisor

The ANOVA table decomposes the variance of MFI 5 into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 5.55332, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean MFI 5 from one level of Virgin HDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table B.6 for MFI 5 by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	.00182963	2	.000914815	.0	.9967
Within groups	6.74298	24	.280957		
Total (Corr.)	6.74481	26			

The StatAdvisor

The ANOVA table decomposes the variance of MFI 5 into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .00325606, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean MFI 5 from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table B.7 for MFI 5 by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	3.7499	2	1.87495	15.03	.1
Within groups	2.99491	24	.124788		
Total (Corr.)	6.74481	26			

The StatAdvisor

The ANOVA table decomposes the variance of MFI 5 into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 15.0251, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean MFI 5 from one level of Recycled HDPE bottle to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table B.8 for MFI 5 by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	2.49872	2	1.24936	7.06	.39
Within groups	4.24609	24	.17692		
Total (Corr.)	6.74481	26			

The StatAdvisor

The ANOVA table decomposes the variance of MFI 5 into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 7.0617, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean MFI 5 from one level of Recycled LDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

APPENDIX C

C. Film Properties of Blended Recycled Polyethylenes Films.

Table C.1 Stress at Break of Machine Direction (MD).

Sample Code	Stress at break of machine direction (MPa)					Data	X	SD	% Variation
	1 st	2 nd	3 rd	4 th	5 th				
Virgin HDPE	44.34	44.09	39.84	42.97	39.43	5	42.13	2.34	5.56
F 1	32.61	31.53	31.56	25.38	29.78	5	30.27	3.30	10.90
F 2	32.26	36.93	40.32	31.89	37.50	5	35.78	3.62	10.12
F 3	34.92	32.73	30.82	32.85	34.29	5	33.12	1.59	4.80
F 4	28.99	24.49	26.42	29.88	29.59	5	27.87	2.33	8.37
F 5	26.74	26.08	26.66	26.18	-	4	26.42	0.33	1.26
F 6	23.03	20.96	15.33	21.06	19.42	5	19.96	2.89	14.47
F 7	22.31	24.26	23.40	27.39	24.03	5	24.28	1.90	7.81
F 8	20.14	24.27	23.47	19.14	-	4	21.76	2.50	11.48
F 9	20.49	20.72	21.84	20.85	-	4	20.98	0.60	2.84
F 10	31.66	34.77	34.26	32.41	-	4	33.28	1.48	4.44
F 11	37.42	39.94	35.26	41.05	41.20	5	38.97	2.57	6.59
F 12	38.15	37.55	43.41	45.34	42.89	5	41.47	3.43	8.28
F 13	33.89	34.16	37.34	37.35	28.34	5	34.22	3.68	10.76
F 14	32.77	34.18	24.56	30.90	27.68	5	30.02	3.90	13.00
F 15	35.10	27.64	30.68	30.06	33.41	5	31.38	2.92	9.32
F 16	27.63	20.77	31.49	27.47	-	4	26.84	4.45	16.59
F 17	19.86	28.31	23.74	27.83	-	4	24.94	3.96	15.87
F 18	24.33	23.91	25.77	21.84	21.44	5	23.46	1.80	7.69
F 19	44.79	39.17	47.18	40.44	43.14	5	42.94	3.24	7.54
F 20	39.09	45.70	38.40	40.21	47.22	5	42.12	4.05	9.61
F 21	34.38	33.49	36.45	37.31	31.48	5	34.62	2.33	6.74
F 22	42.80	46.84	33.25	46.82	41.28	5	42.20	5.57	13.20
F 23	37.26	33.72	37.61	31.72	32.50	5	34.56	2.72	7.87
F 24	43.85	37.58	34.84	36.85	33.01	5	37.23	4.11	11.04
F 25	40.69	41.50	42.11	47.91	29.59	5	40.36	6.66	16.50
F 26	33.42	35.82	32.48	31.68	35.10	5	33.70	1.74	5.16
F 27	25.39	20.98	31.81	30.67	20.56	5	25.88	5.26	20.32

Table C.2 Stress at Break of Transverse Direction (TD).

Sample Code	Stress at break of transverse direction (MPa)					Data	X	SD	% Variation
	1 st	2 nd	3 rd	4 th	5 th				
Virgin HDPE	32.58	34.88	34.29	36.71	37.57	5	35.21	1.98	5.63
F 1	26.66	25.68	26.94	25.74	24.01	5	25.81	1.15	4.44
F 2	25.90	24.86	25.56	22.25	21.36	5	23.99	2.05	8.55
F 3	21.22	19.40	16.85	20.83	22.58	5	20.18	2.18	10.79
F 4	19.60	23.29	20.52	21.99	22.28	5	21.54	1.47	6.82
F 5	20.18	20.60	18.56	20.74	19.11	5	19.84	0.96	4.83
F 6	18.10	17.29	15.55	17.95	19.84	5	17.75	1.55	8.72
F 7	26.47	26.53	27.80	26.53	27.08	5	26.88	0.57	2.12
F 8	20.68	22.82	20.48	17.01	19.76	5	20.15	2.09	10.39
F 9	14.38	14.19	13.73	16.23	16.06	5	14.92	1.15	7.68
F 10	25.10	24.94	24.80	24.69	24.74	5	24.85	0.17	0.67
F 11	24.67	22.09	26.98	23.51	24.57	5	24.36	1.79	7.37
F 12	31.89	28.91	29.22	32.41	31.05	5	30.70	1.57	5.11
F 13	33.72	29.45	28.02	32.12	-	4	30.83	2.57	8.34
F 14	20.56	25.77	20.77	21.28	24.11	5	22.50	2.32	10.31
F 15	16.57	17.72	13.59	17.99	-	4	16.47	2.01	12.23
F 16	21.43	29.84	23.57	20.35	-	4	23.80	4.24	17.84
F 17	24.07	20.09	23.91	26.09	21.70	5	23.17	2.32	10.01
F 18	13.73	18.63	15.09	18.39	-	4	16.46	2.43	14.78
F 19	38.99	33.09	37.64	40.82	36.28	5	37.36	2.92	7.82
F 20	37.26	36.37	36.03	36.54	-	4	36.55	0.52	1.42
F 21	33.89	39.27	34.33	35.01	36.71	5	35.84	2.20	6.13
F 22	28.82	29.30	33.09	35.94	30.21	5	31.47	3.00	9.52
F 23	29.07	30.73	31.96	29.55	26.55	5	29.57	2.03	6.85
F 24	26.59	26.17	25.10	25.86	-	4	25.93	0.63	2.43
F 25	35.42	28.15	29.75	35.10	-	4	32.11	3.70	11.54
F 26	26.59	27.88	25.79	27.64	30.59	5	27.70	1.82	6.58
F 27	27.56	27.89	24.90	23.85	29.08	5	26.66	2.19	8.21

Table C.3 Elongation at Break of Machine Direction (MD).

Sample Code	Elongation at break of machine direction (%)					Data	X	SD	% Variation
	1 st	2 nd	3 rd	4 th	5 th				
Virgin HDPE	500.3	496.6	516.6	484.2	504.9	5	500.5	11.83	2.36
F 1	427.8	424.8	437.8	402.4	396.1	5	417.8	17.73	4.24
F 2	419.0	406.6	446.5	454.8	419.5	5	429.3	20.39	4.75
F 3	424.6	453.9	454.8	442.2	429.5	5	441.0	13.78	3.12
F 4	418.2	436.8	421.1	444.8	425.8	5	429.3	11.17	2.60
F 5	425.3	383.8	390.1	454.0	368.5	5	404.3	34.69	8.58
F 6	410.4	441.3	359.6	398.3	369.5	5	395.8	32.76	8.28
F 7	407.1	417.9	414.9	396.6	-	4	409.1	9.51	2.32
F 8	428.7	493.7	447.3	428.7	-	4	449.6	30.68	6.82
F 9	358.9	371.5	393.5	323.8	382.6	5	366.1	26.89	7.35
F 10	444.8	477.7	445.7	426.2	477.7	5	454.4	22.63	4.98
F 11	436.0	443.8	413.6	463.7	489.1	5	449.2	28.61	6.37
F 12	450.6	468.5	454.9	463.7	-	4	459.4	8.14	1.77
F 13	388.7	408.9	439.7	424.0	375.4	5	407.3	25.96	6.37
F 14	427.1	397.6	443.1	427.3	402.5	5	419.5	19.00	4.53
F 15	447.1	409.7	475.3	421.8	453.3	5	441.4	26.04	5.90
F 16	391.6	329.0	380.6	350.3	-	4	362.9	28.55	7.87
F 17	388.8	413.9	369.3	408.6	429.3	5	402.0	23.31	5.80
F 18	387.3	379.1	394.9	376.1	380.3	5	383.5	7.56	1.97
F 19	472.0	468.7	549.1	457.4	507.5	5	490.9	37.53	7.65
F 20	414.4	439.4	386.6	381.3	441.7	5	412.7	28.39	6.88
F 21	346.9	318.8	378.0	353.4	335.8	5	346.6	21.92	6.32
F 22	420.3	474.6	479.4	430.1	-	4	451.1	30.24	6.70
F 23	482.3	439.5	468.2	453.0	443.8	5	457.4	17.76	3.88
F 24	440.5	423.0	396.1	425.7	389.1	5	414.9	21.54	5.19
F 25	479.2	514.6	463.9	523.6	-	4	495.3	28.39	5.73
F 26	433.7	462.1	473.0	456.5	500.3	5	465.1	24.34	5.23
F 27	431.1	420.7	373.4	433.1	382.7	5	408.2	28.12	6.89

Table C.4 Elongation at Break of Transverse Direction (TD).

Sample Code	Elongation at break of transverse direction (%)					Data	X	SD	% Variation
	1 st	2 nd	3 rd	4 th	5 th				
Virgin HDPE	699.2	622.6	675.3	692.7	631.0	5	664.2	35.33	5.32
F 1	567.7	477.0	543.4	547.4	-	4	533.9	39.38	7.38
F 2	539.5	508.6	564.4	525.1	499.8	5	527.5	25.67	4.87
F 3	557.2	524.7	519.3	493.1	491.4	5	517.1	26.96	5.21
F 4	446.6	469.0	496.0	529.3	481.5	5	484.5	30.92	6.38
F 5	508.4	494.6	475.4	500.5	465.3	5	488.8	17.93	3.67
F 6	505.7	425.0	542.3	513.6	-	4	496.7	50.29	10.13
F 7	555.2	539.4	546.8	520.3	566.7	5	545.7	17.44	3.20
F 8	524.8	539.4	505.3	489.3	470.8	5	505.9	27.33	5.40
F 9	386.5	400.8	423.1	385.4	-	4	399.0	17.56	4.40
F 10	531.8	585.2	487.4	511.7	570.3	5	537.3	40.49	7.54
F 11	433.4	497.7	517.7	524.7	475.4	5	489.8	36.90	7.53
F 12	632.1	595.3	615.6	658.6	633.7	5	627.1	23.47	3.74
F 13	589.8	589.9	607.9	564.6	611.4	5	592.7	18.62	3.14
F 14	530.3	502.9	528.8	545.0	522.2	5	525.8	15.29	2.91
F 15	452.8	330.4	381.0	493.3	-	4	414.4	72.74	17.55
F 16	481.2	537.0	511.0	506.3	-	4	508.9	22.86	4.49
F 17	596.6	543.2	584.2	581.4	532.0	5	567.5	28.15	4.96
F 18	452.5	474.9	475.2	447.1	-	4	462.4	14.74	3.19
F 19	595.8	574.0	624.3	658.1	600.6	5	610.6	32.03	5.25
F 20	594.1	584.7	635.6	627.4	640.0	5	616.4	25.24	4.10
F 21	648.8	755.9	667.4	694.1	710.7	5	695.4	41.39	5.95
F 22	566.7	559.7	586.8	604.6	553.1	5	574.2	21.18	3.69
F 23	601.6	632.6	629.7	588.2	592.1	5	608.8	20.97	3.44
F 24	596.4	674.0	674.7	676.5	646.4	5	653.6	34.31	5.25
F 25	596.1	551.8	544.2	555.1	581.0	5	565.6	21.94	3.88
F 26	596.4	655.2	636.1	584.7	667.2	5	627.9	36.11	5.75
F 27	513.1	569.3	513.7	520.3	557.9	5	534.9	26.69	4.99

Table C.5 Stress at Yield of Machine Direction (MD).

Sample Code	Stress at yield of machine direction (MPa)					Data	X	SD	% Variation
	1 st	2 nd	3 rd	4 th	5 th				
Virgin HDPE	31.11	30.12	26.96	31.00	28.67	5	29.57	1.76	5.94
F 1	19.45	21.44	19.62	21.43	21.29	5	20.65	1.02	4.93
F 2	19.98	23.37	18.84	23.77	-	4	21.49	2.45	11.41
F 3	20.91	20.90	20.64	20.46	-	4	20.73	0.22	1.05
F 4	20.49	17.93	20.08	19.52	20.26	5	19.66	1.03	5.24
F 5	18.87	17.89	18.31	17.80	18.07	5	18.19	0.43	2.35
F 6	15.95	16.49	16.78	15.55	18.16	5	16.59	1.00	6.03
F 7	17.85	19.58	18.90	16.78	17.70	5	18.16	1.09	6.02
F 8	17.83	19.98	16.57	17.83	15.33	5	17.51	1.73	9.87
F 9	16.54	17.51	17.43	15.91	-	4	16.85	0.76	4.54
F 10	24.98	23.32	24.09	22.19	-	4	23.65	1.18	5.01
F 11	22.33	24.32	23.31	23.80	22.81	5	23.31	0.79	3.37
F 12	25.97	25.97	26.47	26.23	26.36	5	26.20	0.23	0.86
F 13	22.49	22.29	22.89	23.91	22.82	5	22.88	0.63	2.73
F 14	22.38	24.95	21.00	21.29	22.89	5	22.50	1.57	6.99
F 15	23.80	21.45	22.25	22.74	23.53	5	22.75	0.96	4.20
F 16	24.74	24.67	26.08	24.65	25.50	5	25.13	0.64	2.54
F 17	21.68	21.36	22.97	24.27	23.82	5	22.82	1.28	5.61
F 18	21.96	20.85	21.02	22.17	19.99	5	21.20	0.89	4.18
F 19	27.79	27.24	26.17	27.06	27.24	5	27.10	0.59	2.17
F 20	26.11	26.45	25.86	26.54	26.71	5	26.33	0.34	1.30
F 21	26.30	27.08	25.77	28.15	25.22	5	26.50	1.15	4.33
F 22	26.82	27.01	27.06	25.22	25.54	5	26.33	0.88	3.34
F 23	27.47	25.26	24.92	26.28	24.41	5	25.67	1.22	4.74
F 24	27.31	26.22	26.96	26.63	26.14	5	26.65	0.49	1.85
F 25	25.94	26.86	28.31	26.19	-	4	26.83	1.06	3.96
F 26	25.65	25.46	23.96	24.69	25.43	5	25.04	0.71	2.82
F 27	22.89	24.49	25.79	24.41	23.21	5	24.16	1.16	4.78

Table C.6 Stress at Yield of Transverse Direction (TD).

Sample Code	Stress at yield of transverse direction (MPa)					Data	X	SD	% Variation
	1 st	2 nd	3 rd	4 th	5 th				
Virgin HDPE	29.74	28.19	29.31	27.89	30.08	5	29.04	0.96	3.31
F 1	20.96	19.23	19.71	18.66	20.02	5	19.72	0.86	4.39
F 2	21.77	21.18	19.53	19.92	20.42	5	20.56	0.91	4.44
F 3	19.00	18.38	18.87	18.01	18.77	5	18.61	0.41	2.18
F 4	17.75	16.62	16.94	17.55	16.48	5	17.07	0.56	3.29
F 5	18.52	16.53	16.65	17.73	-	4	17.36	0.94	5.44
F 6	15.95	16.46	16.78	15.55	18.16	5	16.58	1.00	6.04
F 7	17.85	19.58	18.90	16.78	17.70	5	18.16	1.09	6.02
F 8	17.47	16.64	19.43	17.47	20.07	5	18.22	1.46	8.01
F 9	15.02	15.26	13.52	16.30	16.86	5	15.39	1.29	8.37
F 10	24.49	22.09	23.57	22.89	21.92	5	22.99	1.07	4.64
F 11	21.11	20.35	22.89	21.29	21.12	5	21.35	0.93	4.37
F 12	21.76	21.36	23.11	19.00	-	4	21.31	1.71	8.03
F 13	23.35	19.76	20.42	20.39	21.13	5	21.01	1.40	6.64
F 14	20.00	22.21	21.36	20.43	22.81	5	21.36	1.18	5.51
F 15	24.05	22.38	21.29	21.12	22.63	5	22.29	1.18	5.30
F 16	22.60	22.80	23.50	23.40	-	4	23.08	0.44	1.92
F 17	21.11	22.13	23.69	23.76	21.11	5	22.36	1.31	5.88
F 18	23.19	19.27	20.83	20.46	18.79	5	20.51	1.72	8.37
F 19	26.74	26.47	26.26	26.26	26.02	5	26.35	0.27	1.02
F 20	24.25	24.50	23.74	23.96	-	4	24.11	0.33	1.38
F 21	26.26	26.34	24.75	25.62	25.09	5	25.61	0.70	2.74
F 22	20.18	24.26	23.53	24.07	22.66	5	22.94	1.66	7.25
F 23	24.41	24.62	24.90	25.54	26.02	5	25.10	0.67	2.66
F 24	26.16	26.70	25.78	26.09	25.56	5	26.06	0.43	1.66
F 25	25.98	23.88	24.64	24.17	25.62	5	24.86	0.91	3.66
F 26	26.16	24.62	24.49	24.16	25.25	5	24.94	0.79	3.17
F 27	25.09	22.41	25.00	23.57	23.40	5	23.89	1.14	4.77

Table C.7 Elongation at Yield of Machine Direction (MD).

Sample Code	Elongation at yield of machine direction (%)					Data	X	SD	% Variation
	1 st	2 nd	3 rd	4 th	5 th				
Virgin HDPE	14.75	16.80	14.43	15.06	16.84	5	15.58	1.16	7.43
F 1	15.49	14.16	17.00	17.09	17.11	5	16.17	1.32	8.13
F 2	15.77	19.59	10.49	11.31	-	4	14.29	4.23	29.58
F 3	15.06	14.77	12.98	13.31	15.94	5	14.41	1.24	8.60
F 4	11.67	14.63	13.05	17.46	15.53	5	14.47	2.23	15.43
F 5	12.53	13.36	13.92	13.87	16.34	5	14.00	1.42	10.14
F 6	12.07	15.49	14.01	13.13	14.72	5	13.88	1.34	9.63
F 7	14.52	13.76	12.56	15.35	-	4	14.05	1.19	8.44
F 8	14.15	16.41	14.15	14.74	-	4	14.86	1.07	7.19
F 9	13.86	14.30	16.24	15.05	14.03	5	14.70	0.98	6.64
F 10	16.53	16.87	16.23	17.04	-	4	16.67	0.36	2.16
F 11	17.43	10.85	15.06	13.22	16.82	5	14.68	2.70	18.37
F 12	10.25	17.99	14.80	14.88	17.00	5	14.98	2.98	19.90
F 13	14.69	17.55	19.23	14.97	15.27	5	16.34	1.97	12.07
F 14	13.19	14.68	13.22	15.13	15.85	5	14.41	1.18	8.19
F 15	13.67	17.28	14.36	16.90	-	4	15.55	1.80	11.60
F 16	18.12	16.99	15.88	16.98	15.18	5	16.63	1.13	6.81
F 17	15.42	14.52	13.75	14.89	-	4	14.65	0.70	4.79
F 18	11.52	20.39	15.06	10.15	-	4	14.28	4.57	31.99
F 19	16.00	17.46	17.63	14.14	16.10	5	16.27	1.41	8.64
F 20	15.96	15.10	13.95	17.25	16.89	5	15.83	1.34	8.49
F 21	15.33	14.58	19.83	14.17	16.38	5	16.06	2.27	14.14
F 22	16.08	16.47	15.97	15.85	15.75	5	16.02	0.28	1.74
F 23	12.56	14.36	14.94	13.73	16.69	5	14.46	1.53	10.58
F 24	17.61	13.65	15.15	18.70	17.95	5	16.61	2.12	12.79
F 25	13.05	18.54	18.41	14.91	-	4	16.23	2.70	16.67
F 26	15.84	18.20	14.06	13.39	18.23	5	15.94	2.26	14.16
F 27	13.35	16.43	13.37	14.58	14.01	5	14.35	1.27	8.85

Table C.8 Elongation at Yield of Transverse Direction (TD).

Sample Code	Elongation at yield of transverse direction (%)					Data	X	SD	% Variation
	1 st	2 nd	3 rd	4 th	5 th				
Virgin HDPE	6.312	6.141	6.348	6.238	6.228	5	6.253	0.08	1.29
F 1	5.745	6.128	6.765	6.028	6.131	5	6.159	0.37	6.06
F 2	5.993	6.754	6.517	5.349	6.267	5	6.176	0.54	8.78
F 3	6.763	7.012	6.674	7.289	6.490	5	6.846	0.31	4.54
F 4	6.482	6.301	5.394	6.877	6.518	5	6.314	0.56	8.79
F 5	6.327	7.146	6.674	6.602	6.188	5	6.587	0.37	5.61
F 6	5.940	4.929	5.677	5.478	6.709	5	5.747	0.65	11.37
F 7	6.209	6.878	6.686	6.441	-	4	6.554	0.29	4.44
F 8	6.997	6.120	6.230	7.566	6.540	5	6.691	0.60	8.91
F 9	6.485	6.334	6.566	6.293	6.515	5	6.439	0.12	1.84
F 10	5.300	5.461	4.824	6.096	6.017	5	5.540	0.53	9.52
F 11	6.581	6.475	6.530	6.799	6.713	5	6.620	0.13	2.02
F 12	6.035	5.894	5.253	5.565	-	4	5.687	0.35	6.15
F 13	5.851	5.559	6.702	6.308	5.196	5	5.923	0.60	10.06
F 14	6.636	5.467	5.739	5.503	8.248	5	6.319	1.18	18.64
F 15	5.396	5.067	5.483	5.005	5.283	5	5.247	0.21	3.93
F 16	6.242	6.234	6.037	6.140	-	4	6.163	0.10	1.56
F 17	6.217	6.594	6.669	6.044	5.601	5	6.225	0.43	6.98
F 18	5.869	5.379	5.262	4.958	6.112	5	5.516	0.47	8.48
F 19	5.557	7.397	5.110	6.024	-	4	6.022	0.99	16.43
F 20	6.778	7.658	5.186	5.466	-	4	6.272	1.16	18.42
F 21	4.665	5.215	4.837	5.953	4.853	5	5.105	0.51	10.09
F 22	5.712	5.762	5.821	5.666	5.812	5	5.755	0.07	1.15
F 23	5.640	6.017	5.151	6.420	6.497	5	5.945	0.56	9.44
F 24	5.354	6.911	5.778	6.305	6.142	5	6.098	0.58	9.57
F 25	6.149	6.796	6.914	7.611	-	4	6.868	0.60	8.72
F 26	5.354	6.250	5.660	5.720	5.313	5	5.659	0.38	6.65
F 27	7.221	6.950	5.535	6.742	-	4	6.612	0.74	11.26

APPENDIX D

D. Analysis of Variance (ANOVA) Table of Film Properties.

D.1 One-way ANOVA Table of Film Properties (Machine Direction).

ANOVA Table D.1 for Elongation at Break by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	22453.5	7	3207.64	3.62	.110
Within groups	17710.4	20	885.518		
Total (Corr.)	40163.8	27			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 3.62233, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Elongation at Break from one level of Virgin HDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.2 for Elongation at Break by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	2004.65	2	1002.33	.74	.4887
Within groups	32603.6	24	1358.48		
Total (Corr.)	34608.2	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .737829, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Break from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table D.3 for Elongation at Break by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	2689.13	2	1344.57	1.01	.3788
Within groups	31919.1	24	1329.96		
Total (Corr.)	34608.2	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 1.01098, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Break from one level of Recycled HDPE bottle to another at the 95.0% confidence level.

ANOVA Table D.4 for Elongation at Break by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	2510.74	2	1255.37	.94	.4050
Within groups	32097.5	24	1337.4		
Total (Corr.)	34608.2	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .938669, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Break from one level of Recycled LDPE to another at the 95.0% confidence level.

ANOVA Table D.5 for Stress at Break by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	1118.99	7	159.855	12.48	.0
Within groups	256.086	20	12.8043		
Total (Corr.)	1375.07	27			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 12.4845, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Break from one level of Virgin HDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.6 for Stress at Break by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	81.6913	2	40.8456	.82	.4509
Within groups	1190.5	24	49.6044		
Total (Corr.)	1272.2	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .823428, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Stress at Break from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table D.7 for Stress at Break by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	438.754	2	219.377	6.32	.62
Within groups	833.442	24	34.7267		
Total (Corr.)	1272.2	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 6.31724, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Break from one level of Recycled HDPE bottle to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.8 for Stress at Break by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	482.701	2	241.351	7.34	.33
Within groups	789.495	24	32.8956		
Total (Corr.)	1272.2	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 7.33686, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Break from one level of Recycled LDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.9 for Elongation at Yield by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	8.68052	7	1.24007	1.68	.1715
Within groups	14.7794	20	.73897		
Total (Corr.)	23.4599	27			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 1.67811, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Yield from one level of Virgin HDPE to another at the 95.0% confidence level.

ANOVA Table D.10 for Elongation at Yield by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	3.11162	2	1.55581	1.85	.1795
Within groups	20.2194	24	.842477		
Total (Corr.)	23.3311	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 1.84671, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Yield from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table D.11 for Elongation at Yield by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	2.42869	2	1.21434	1.39	.2674
Within groups	20.9024	24	.870932		
Total (Corr.)	23.3311	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 1.3943, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Yield from one level of Recycled HDPE bottle to another at the 95.0% confidence level.

ANOVA Table D.12 for Elongation at Yield by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	6.91369	2	3.45684	5.05	.147
Within groups	16.4174	24	.684057		
Total (Corr.)	23.3311	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 5.05344, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Elongation at Yield from one level of Recycled LDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.13 for Stress at Yield by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	207.025	7	29.575	4.67	.31
Within groups	126.616	20	6.33081		
Total (Corr.)	333.641	27			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 4.6716, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Yield from one level of Virgin HDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.14 for Stress at Yield by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	5.87636	2	2.93818	.25	.7816
Within groups	283.22	24	11.8008		
Total (Corr.)	289.096	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .24898, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Stress at Yield from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table D.15 for Stress at Yield by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	21.7454	2	10.8727	.98	.3913
Within groups	267.351	24	11.1396		
Total (Corr.)	289.096	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .976036, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Stress at Yield from one level of Recycled HDPE bottle to another at the 95.0% confidence level.

ANOVA Table D.16 for Stress at Yield by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	238.141	2	119.071	56.08	.0
Within groups	50.9553	24	2.12314		
Total (Corr.)	289.096	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 56.0823, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Yield from one level of Recycled LDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

D.2 One-way ANOVA Table of Film Properties (Transverse Direction).

ANOVA Table D.17 for Elongation at Break by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	73590.7	7	10513.0	3.11	.218
Within groups	67653.7	20	3382.68		
Total (Corr.)	141244.0	27			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 3.10787, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Elongation at Break from one level of Virgin HDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.18 for Elongation at Break by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	10207.0	2	5103.5	1.04	.3675
Within groups	117314.0	24	4888.09		
Total (Corr.)	127521.0	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 1.04407, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Break from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table D.19 for Elongation at Break by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	10498.7	2	5249.33	1.08	.3567
Within groups	117022.0	24	4875.93		
Total (Corr.)	127521.0	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 1.07658, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Break from one level of Recycled HDPE bottle to another at the 95.0% confidence level.

ANOVA Table D.20 for Elongation at Break by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	59557.7	2	29778.8	10.52	.5
Within groups	67963.4	24	2831.81		
Total (Corr.)	127521.0	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 10.5158, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Elongation at Break from one level of Recycled LDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.21 for Stress at Break by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	652.204	7	93.1721	4.33	.46
Within groups	430.058	20	21.5029		
Total (Corr.)	1082.26	27			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 4.333, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Break from one level of Virgin HDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.22 for Stress at Break by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	6.08436	2	3.04218	.7	.9287
Within groups	984.49	24	41.0204		
Total (Corr.)	990.574	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .0741625, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Stress at Break from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table D.23 for Stress at Break by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	278.674	2	139.337	4.70	.190
Within groups	711.9	24	29.6625		
Total (Corr.)	990.574	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 4.69741, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Break from one level of Recycled HDPE bottle to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.24 for Stress at Break by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	514.165	2	257.083	12.95	.2
Within groups	476.409	24	19.8504		
Total (Corr.)	990.574	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Break into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 12.951, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Break from one level of Recycled LDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.25 for Elongation at Yield by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	1.06051	7	.151502	.64	.7179
Within groups	4.73338	20	.236669		
Total (Corr.)	5.7939	27			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .640142, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Yield from one level of Virgin HDPE to another at the 95.0% confidence level.

ANOVA Table D.26 for Elongation at Yield by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	1.11506	2	.55753	2.87	.762
Within groups	4.66032	24	.19418		
Total (Corr.)	5.77537	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 2.8712, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Yield from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table D.27 for Elongation at Yield by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	.198395	2	.0991974	.43	.6574
Within groups	5.57698	24	.232374		
Total (Corr.)	5.77537	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .426886, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Yield from one level of Recycled HDPE bottle to another at the 95.0% confidence level.

ANOVA Table D.28 for Elongation at Yield by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	1.09456	2	.547279	2.81	.803
Within groups	4.68082	24	.195034		
Total (Corr.)	5.77537	26			

The StatAdvisor

The ANOVA table decomposes the variance of Elongation at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 2.80607, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Elongation at Yield from one level of Recycled LDPE to another at the 95.0% confidence level.

ANOVA Table D.29 for Stress at Yield by Virgin HDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	179.918	7	25.7025	4.08	.62
Within groups	126.038	20	6.30192		
Total (Corr.)	305.956	27			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 4.07852, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Yield from one level of Virgin HDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

ANOVA Table D.30 for Stress at Yield by Recycled HDPE film

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	9.17482	2	4.58741	.45	.6406
Within groups	242.652	24	10.1105		
Total (Corr.)	251.827	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .453727, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Stress at Yield from one level of Recycled HDPE film to another at the 95.0% confidence level.

ANOVA Table D.31 for Stress at Yield by Recycled HDPE bottle

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	2.29282	2	1.14641	.11	.8961
Within groups	249.534	24	10.3973		
Total (Corr.)	251.827	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals .110261, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to .05, there is not a statistically significant difference between the mean Stress at Yield from one level of Recycled HDPE bottle to another at the 95.0% confidence level.

ANOVA Table D.32 for Stress at Yield by Recycled LDPE

Analysis of Variance					
Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Between groups	215.771	2	107.886	71.81	.0
Within groups	36.056	24	1.50233		
Total (Corr.)	251.827	26			

The StatAdvisor

The ANOVA table decomposes the variance of Stress at Yield into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 71.812, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than .05, there is a statistically significant difference between the mean Stress at Yield from one level of Recycled LDPE to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

APPENDIX E

E. Rheological Properties of Blended Recycled Polyethylene Resins.

Table E.1 Shear Rate ($\dot{\gamma}$) and Viscosity (η) of Virgin HDPE and Recycled Polyethylene.

$\dot{\gamma}$ of virgin HDPE (/s)	η of virgin HDPE (Pa.s)	$\dot{\gamma}$ of Recycled HDPE (bottle) (/s)	η of Recycled HDPE (bottle) (Pa.s)	$\dot{\gamma}$ of Recycled HDPE (film) (/s)	η of Recycled HDPE (film) (Pa.s)	$\dot{\gamma}$ of Recycled LDPE (/s)	η of Recycled LDPE (Pa.s)
14.14	6324.82	10.32	1717.35	15.88	5834.76	10.21	1529.99
88.45	1370.15	55.26	793.06	85.09	1677.98	54.91	626.10
149.69	852.32	115.03	496.64	176.20	980.02	114.77	401.91
711.38	240.83	375.00	244.69	562.04	404.49	378.68	187.43
1348.80	133.43	657.39	170.28	966.58	262.55	670.39	126.87
2098.78	93.36	958.03	131.92	1384.27	197.82	985.83	97.91
3435.49	63.62	1437.25	100.35	2027.37	137.13	1498.15	72.08
10132.30	29.19	3251.96	57.28	4273.12	73.64	3535.64	38.19
22340.70	13.87	5382.16	39.39	6629.78	53.76	6120.97	24.94
46992.50	6.75	7832.99	29.55	9066.48	41.80	9369.68	17.75
113125.00	2.87	10625.40	23.16	11564.10	33.57	13470.80	13.05
170247.00	1.89	17438.00	15.55	16735.00	23.75	25725.00	7.42
		31719.30	9.55	59999.00	7.17	70178.30	2.94
		45590.95	6.97				

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Table E.2 Shear Rate ($\dot{\gamma}$) and Viscosity (η) of the Polyethylene Blended Resins.

VHDPE70%, Recycled HDPE(film)10% Recycled HDPE(bottle)10%, Recycled LDPE10%		VHDPE60%, Recycled HDPE(film)10% Recycled HDPE(bottle)10%, Recycled LDPE20%		VHDPE50%, Recycled HDPE(film)10% Recycled HDPE(bottle)10%, Recycled LDPE30%	
$\dot{\gamma}$ (/s)	η (Pa.s)	$\dot{\gamma}$ (/s)	η (Pa.s)	$\dot{\gamma}$ (/s)	η (Pa.s)
10.18	10215.70	10.03	8253.93	10.91	5801.11
60.02	2345.74	40.93	3289.36	93.89	1655.71
86.99	1779.13	82.92	1930.16	254.14	800.68
281.16	690.55	256.31	887.66	414.45	532.49
501.63	448.62	435.99	559.10	574.45	394.73
755.92	327.22	621.59	380.95	813.37	292.33
1235.78	197.98	909.64	271.79	1605.46	160.54
6999.90	48.40	1959.19	151.97	2394.35	117.19
77250.00	4.08	3177.07	103.34	3180.97	94.90
128753.00	2.64	4637.03	73.28	3964.79	75.57
		6480.59	53.30	5533.99	53.83
		13018.50	27.37	9999.90	26.03

Table E.3 Shear Rate ($\dot{\gamma}$) and Viscosity (η) of the Polyethylene Blended Resins.

VHDPE50%, Recycled HDPE(film)20% Recycled HDPE(bottle)20%, Recycled LDPE10%		VHDPE40%, Recycled HDPE(film)20% Recycled HDPE(bottle)20%, Recycled LDPE20%		VHDPE30%, Recycled HDPE(film)20% Recycled HDPE(bottle)20%, Recycled LDPE30%	
$\dot{\gamma}$ (/s)	η (Pa.s)	$\dot{\gamma}$ (/s)	η (Pa.s)	$\dot{\gamma}$ (/s)	η (Pa.s)
12.91	5526.72	13.22	4279.45	8.84	4029.89
71.30	1602.58	72.23	1450.47	47.03	1983.94
150.87	943.13	151.60	873.91	98.31	1191.99
506.93	393.67	499.15	370.65	332.63	500.76
903.03	254.40	876.52	243.02	613.98	313.82
1330.97	187.55	1276.40	184.69	954.48	224.46
2022.01	133.28	1908.62	135.50	1625.25	145.12
4693.71	63.09	4239.35	67.90	11722.40	24.05
7883.74	40.16	6850.50	44.86	77250.00	3.87
11581.70	28.55	9701.48	33.40	102997.00	3.05
15801.70	21.49	12768.80	26.18	128698.00	2.56
26027.80	13.34	19553.20	17.81	180247.00	1.95
46785.40	7.66	31258.50	11.54	257497.00	1.43

Table E.4 Shear Rate ($\dot{\gamma}$) and Viscosity (η) of the Polyethylene Blended Resins.

VHDPE30%, Recycled HDPE(film)30% Recycled HDPE(bottle)30%, Recycled LDPE10%		VHDPE20%, Recycled HDPE(film)30% Recycled HDPE(bottle)30%, Recycled LDPE20%		VHDPE10%, Recycled HDPE(film)30% Recycled HDPE(bottle)30%, Recycled LDPE30%	
$\dot{\gamma}$ (/s)	η (Pa.s)	$\dot{\gamma}$ (/s)	η (Pa.s)	$\dot{\gamma}$ (/s)	η (Pa.s)
8.38	7325.20	9.31	5462.17	8.38	4462.75
42.16	2393.54	43.51	2124.36	42.16	1624.69
84.61	1424.71	85.53	1326.95	84.61	1098.30
255.25	632.65	251.35	650.63	255.25	514.26
426.40	395.20	579.51	341.49	907.05	225.16
598.29	283.54	824.32	271.27	2643.56	120.25
856.43	224.71	1636.39	161.28	3502.96	88.78
1719.75	132.65	2445.51	118.11	4357.55	73.94
2586.40	97.02	3252.46	95.41	6064.70	56.03
3454.81	77.38	4056.60	79.24	8611.16	41.58
4323.21	65.11	5666.55	60.00		
6068.58	49.52	8074.13	44.32		
8690.99	36.82				

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APPENDIX F

F. Statistic of Data

Standard deviation (s), Equation (F1) and t distribution was used to determine the distribution of experiments values[44].

$$s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}} \quad (\text{F1})$$

where n is the number of sample,

x_i is the experimental of i experiment,

\bar{x} is the arithmetic experiment mean of a set of values.

The true data (μ) was calculated following the equation (F2). The t-values were obtained from the tabulated statistical table.

$$\mu = \frac{\bar{x} \pm (tSD)}{\sqrt{n}} \quad (\text{F2})$$

From the statistical table:

At 90% confidence, n = 3, to obtain t = 2.92.

At 90% confidence, n = 5, to obtain t = 2.13.

The set values were often a single result which deviated from the mean far more than any of the other, the result should be rejected. The Q-test was one of the most reliable of the objective tests available [44].

$$Q = \frac{\text{suspect value} - \text{nearest value}}{\text{largest value} - \text{smallest value}} \quad (\text{F3})$$

The Q-test was employed in this study to check whether or not it was reliable to reject a value which deviated far from the mean. The Q experimental value was determined from equation (F3) which was finally compared with those tabulated in a statistical table. If $Q (\text{experimental}) > Q (\text{table})$, the value could be reject. In this thesis, Q was equal to 0.64 at 90% confidence for 5 results.



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APPENDIX G

7. Percent Crystallinities from X-ray Diffraction

The polymer's percent crystallinity from X-ray diffraction could be calculated from:

$$\% \text{ Crystallinity} = \frac{\text{area under crystalline region}}{\text{area under crystalline region} + \text{area under amorphous region}} \times 100 \text{ (G1)}$$

The area is determined using a cut-and-weigh method (using a filter paper with a diameter of 100 mm produced by Schleicher&Schuell, Dassel, Germany)

Table 7.1 Percent Crystallinities of Polyethylene Films from X-ray Diffraction.

Material (%)				Area under Crystalline Region (g)	Area under Amorphous Region (g)	Crystallinity (%)
Virgin HDPE	Recycled HDPE (film)	Recycled HDPE (bottle)	Recycled LDPE			
100	-	-	-	0.038	0.011	77.6
-	100	-	-	0.033	0.011	75.0
-	-	100	-	0.033	0.013	71.7
-	-	-	100	0.017	0.016	51.5
70	10	10	10	0.042	0.014	75.0
60	10	10	20	0.031	0.012	72.1
50	10	10	30	0.029	0.012	70.7
50	20	20	10	0.029	0.010	74.4
40	20	20	20	0.031	0.011	73.8
30	20	20	30	0.033	0.014	70.2
30	30	30	10	0.032	0.013	71.1
20	30	30	20	0.032	0.014	69.5
10	30	30	30	0.029	0.014	67.4

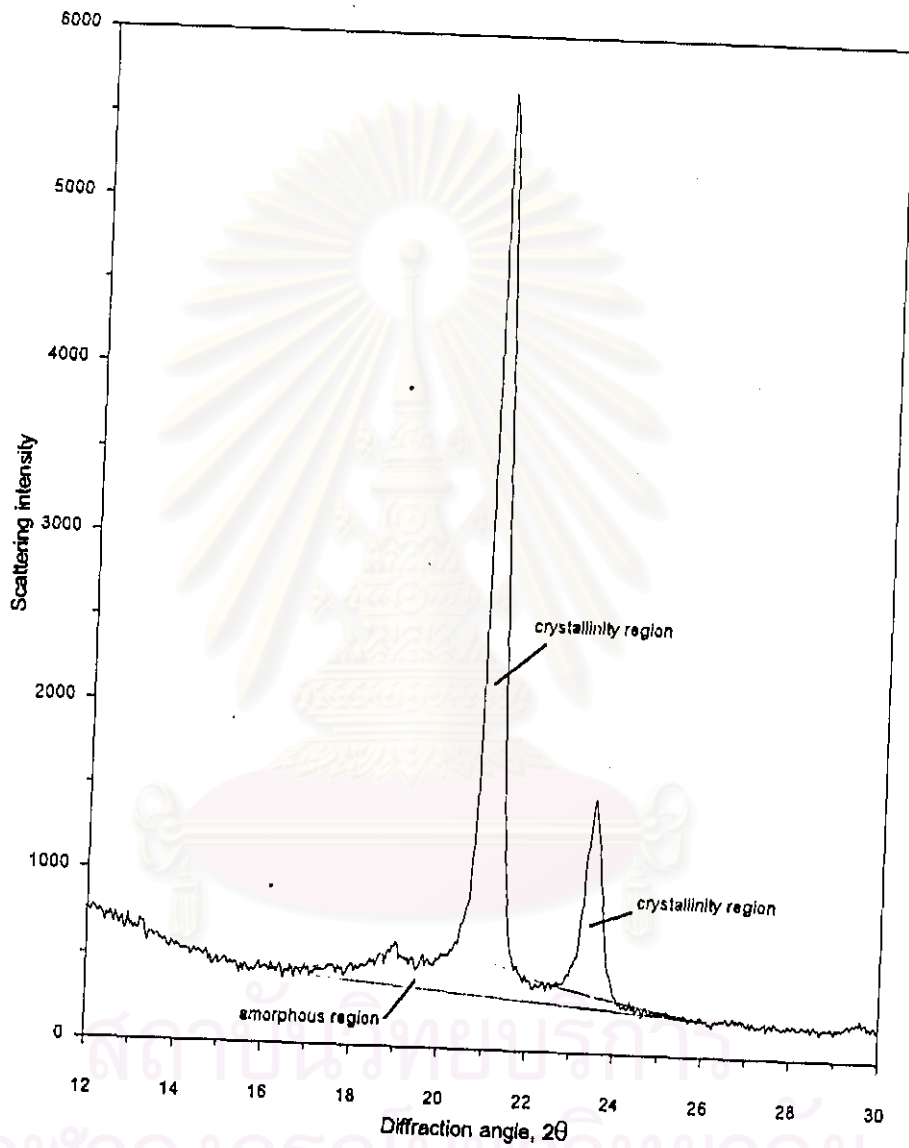


Figure G.1 X-ray diffraction curve of virgin HDPE.

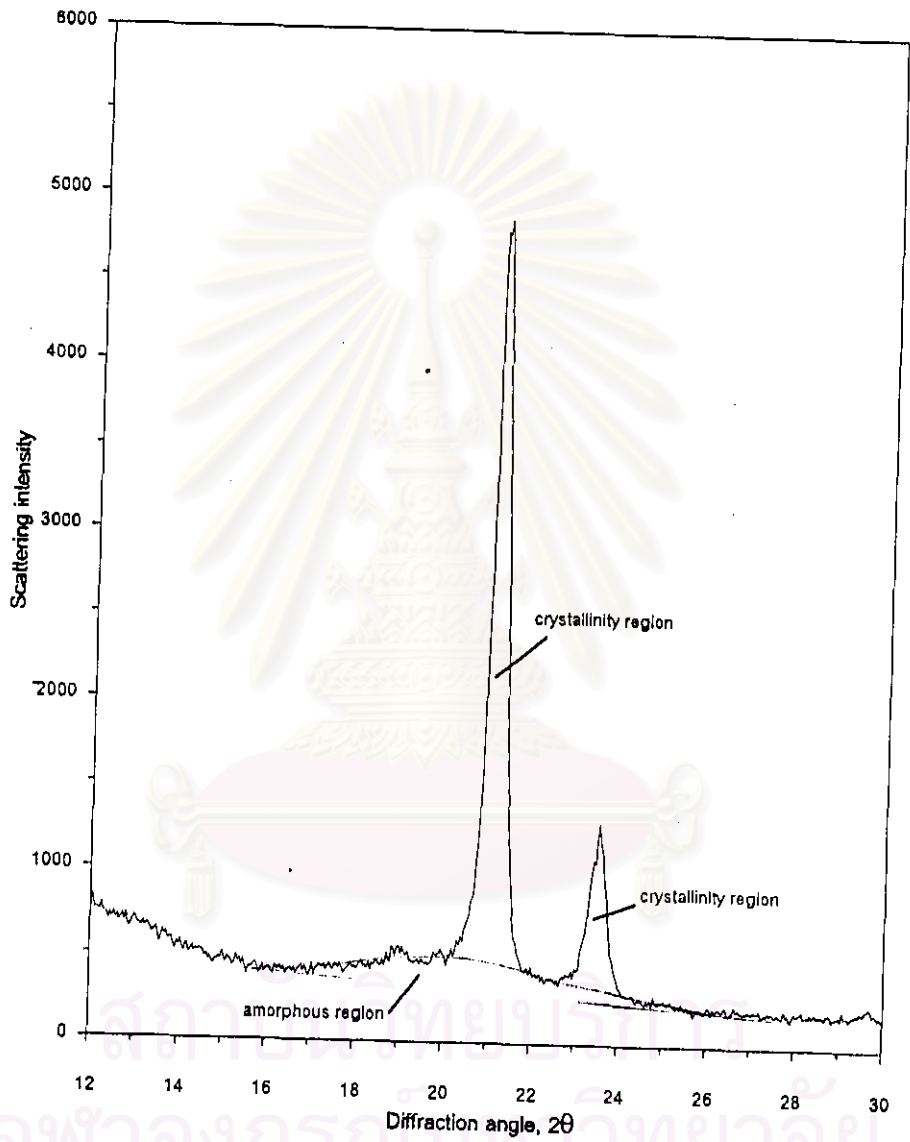


Figure G.2 X-ray diffraction curve of recycled HDPE (film).

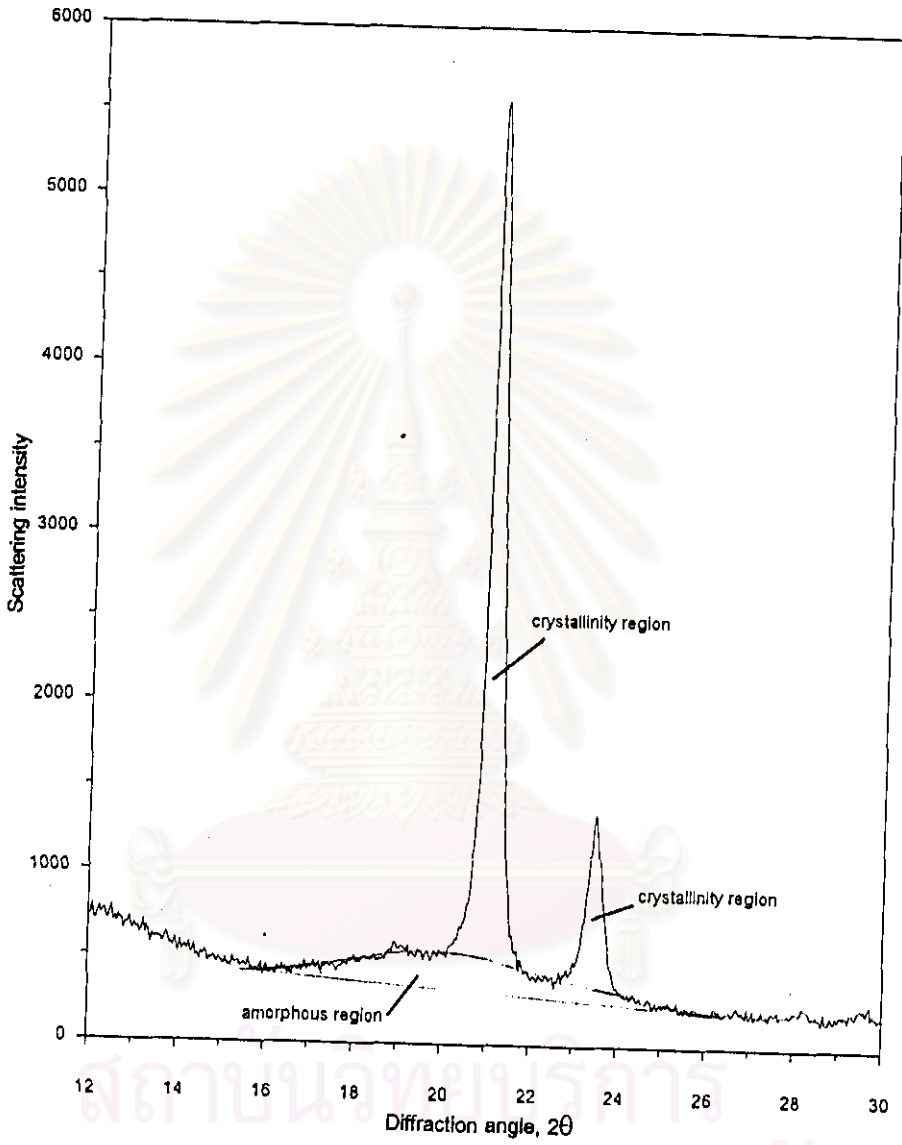


Figure G.3 X-ray diffraction curve of recycled HDPE (bottle).

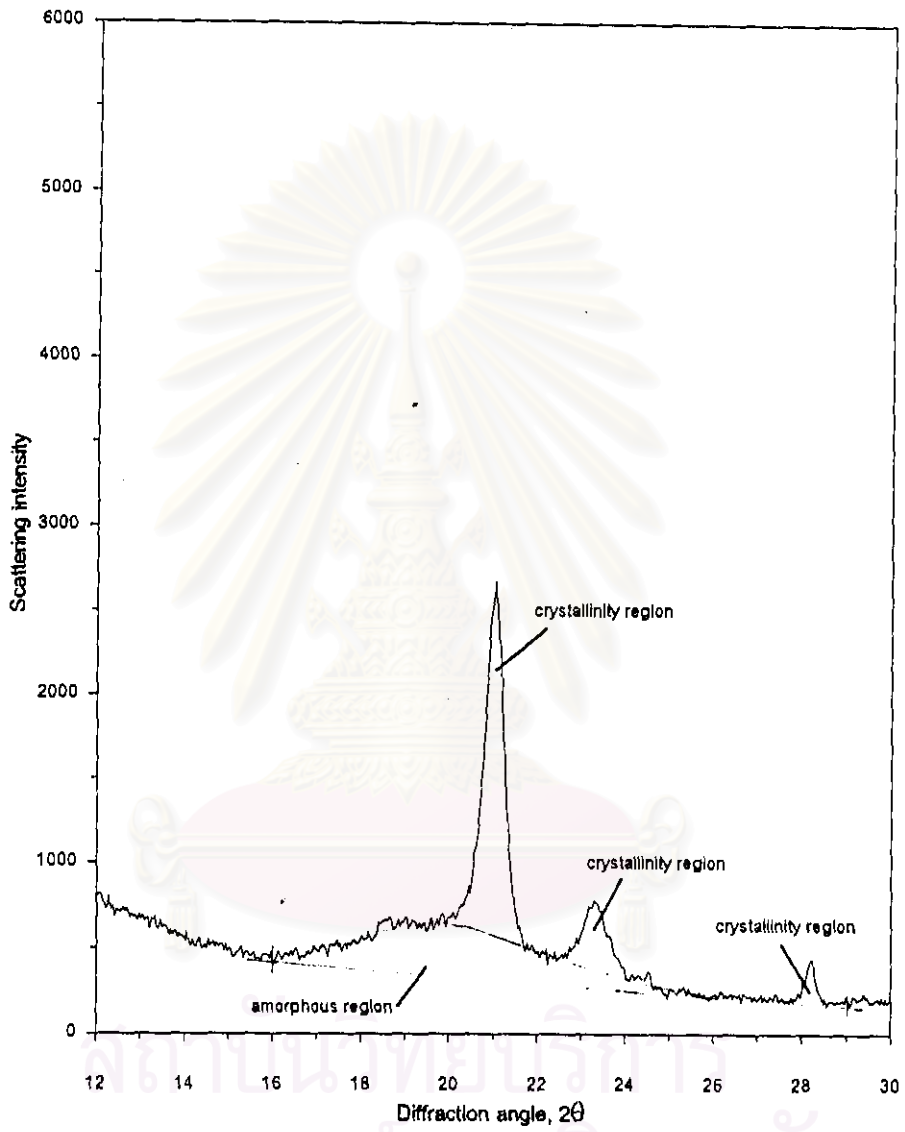


Figure G.4 X-ray diffraction curve of recycled LDPE.

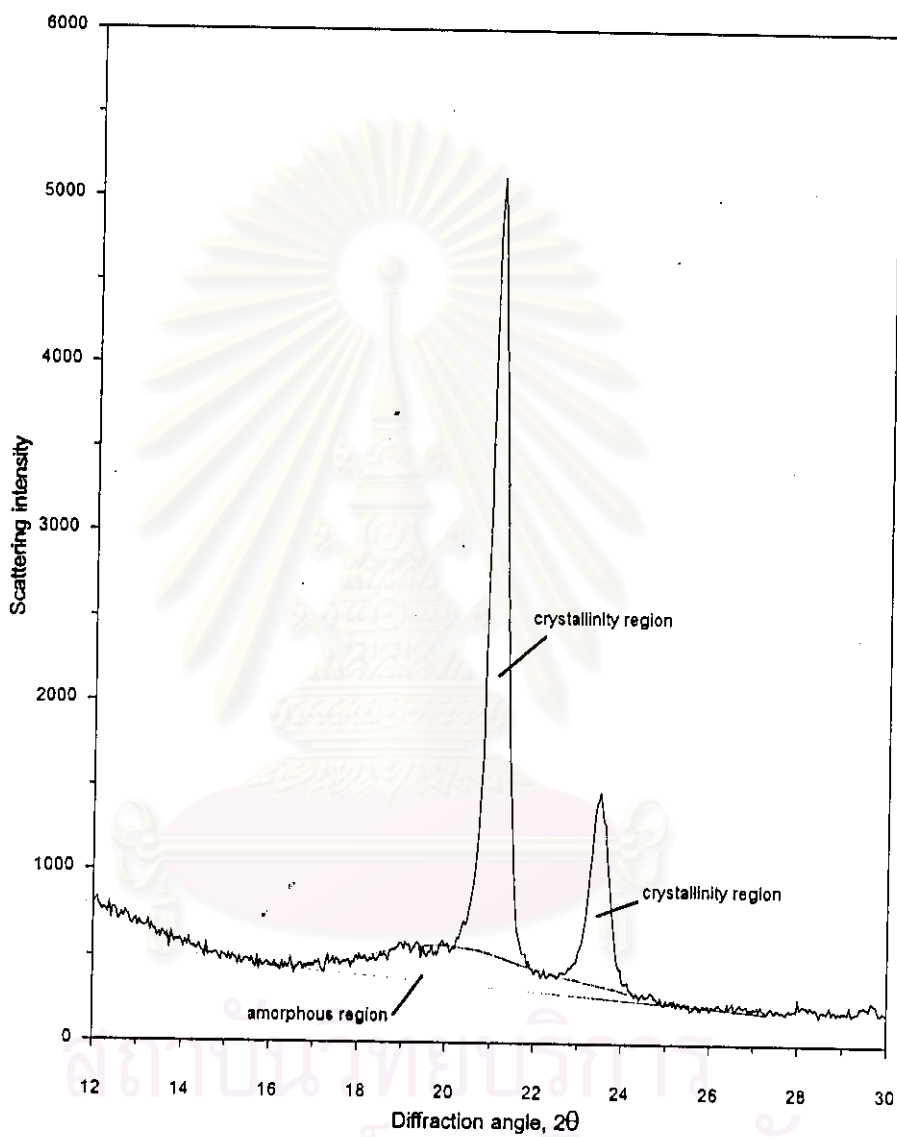


Figure G.5 X-ray diffraction curve of the blended film.

(virgin HDPE 70%, recycled HDPE (film) 10%, recycled HDPE (bottle)10%, recycled LDPE 10%)

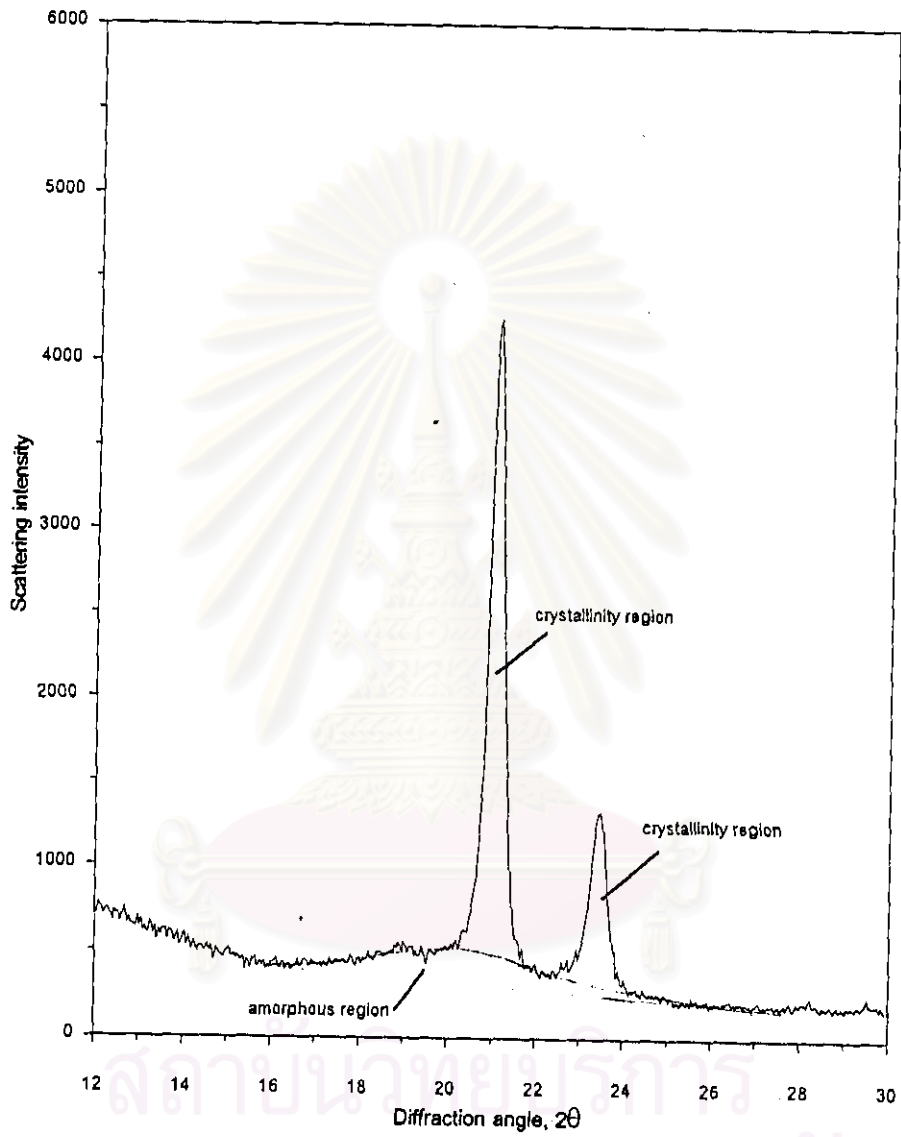


Figure G.6 X-ray diffraction curve of the blended film.

(virgin HDPE 60%, recycled HDPE (film) 10%, recycled HDPE (bottle)10%, recycled LDPE 20%)

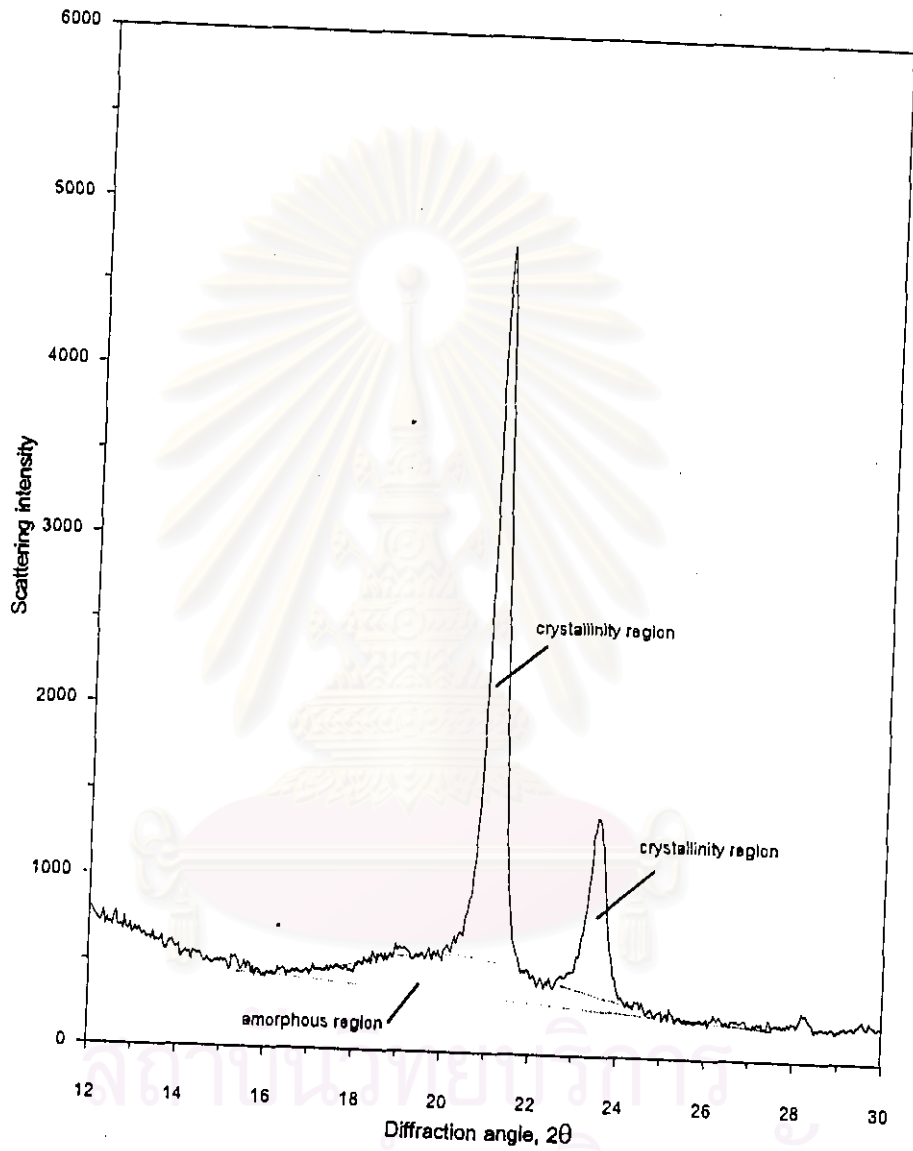


Figure G.7 X-ray diffraction curve of the blended film.

(virgin HDPE 50%, recycled HDPE (film) 10%, recycled HDPE (bottle)10%, recycled LDPE 30%)

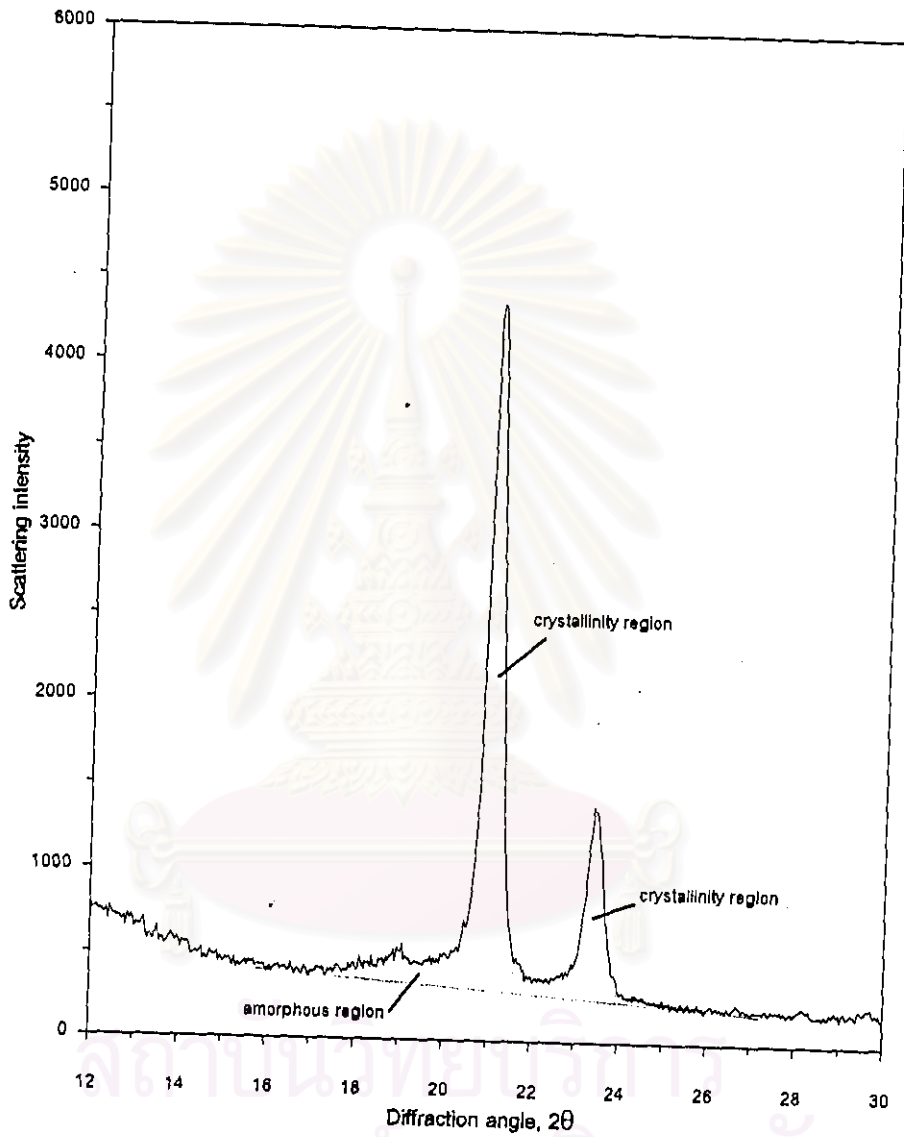


Figure G.8 X-ray diffraction curve of the blended film.

(virgin HDPE 50%, recycled HDPE (film) 20%, recycled HDPE (bottle) 20%, recycled LDPE 10%)

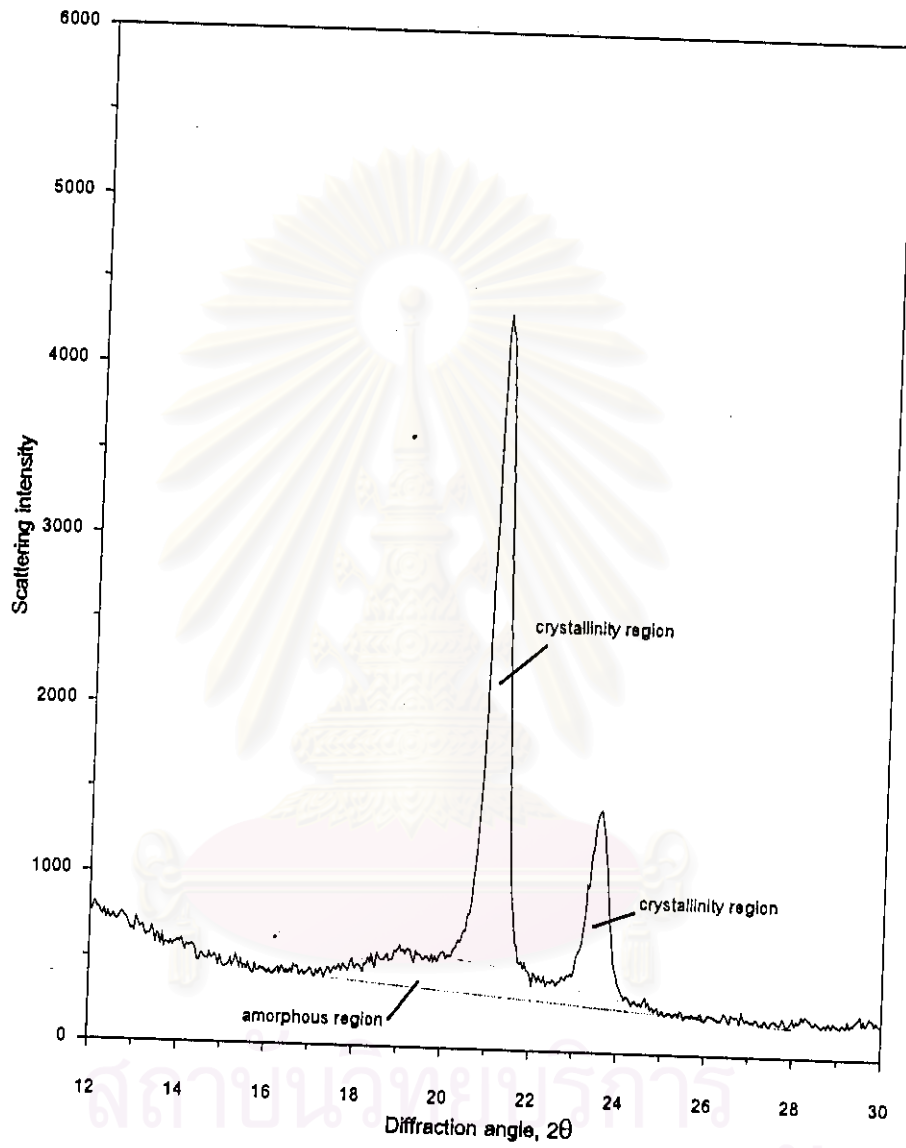


Figure G.9 X-ray diffraction curve of the blended film.

(virgin HDPE 40%, recycled HDPE (film) 20%, recycled HDPE (bottle) 20%, recycled LDPE 20%)

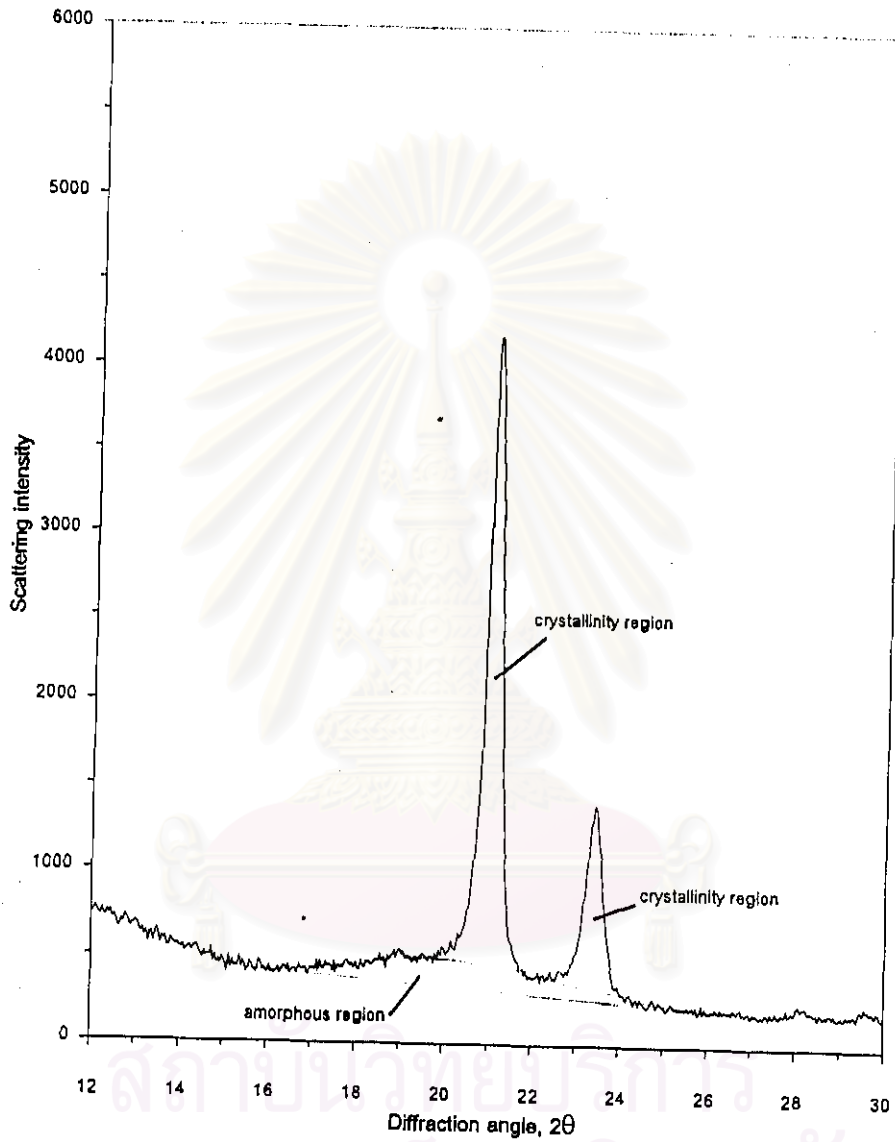


Figure G.10 X-ray diffraction curve of the blended film.

(virgin HDPE 30%, recycled HDPE (film) 20%, recycled HDPE (bottle) 20%, recycled LDPE 30%)

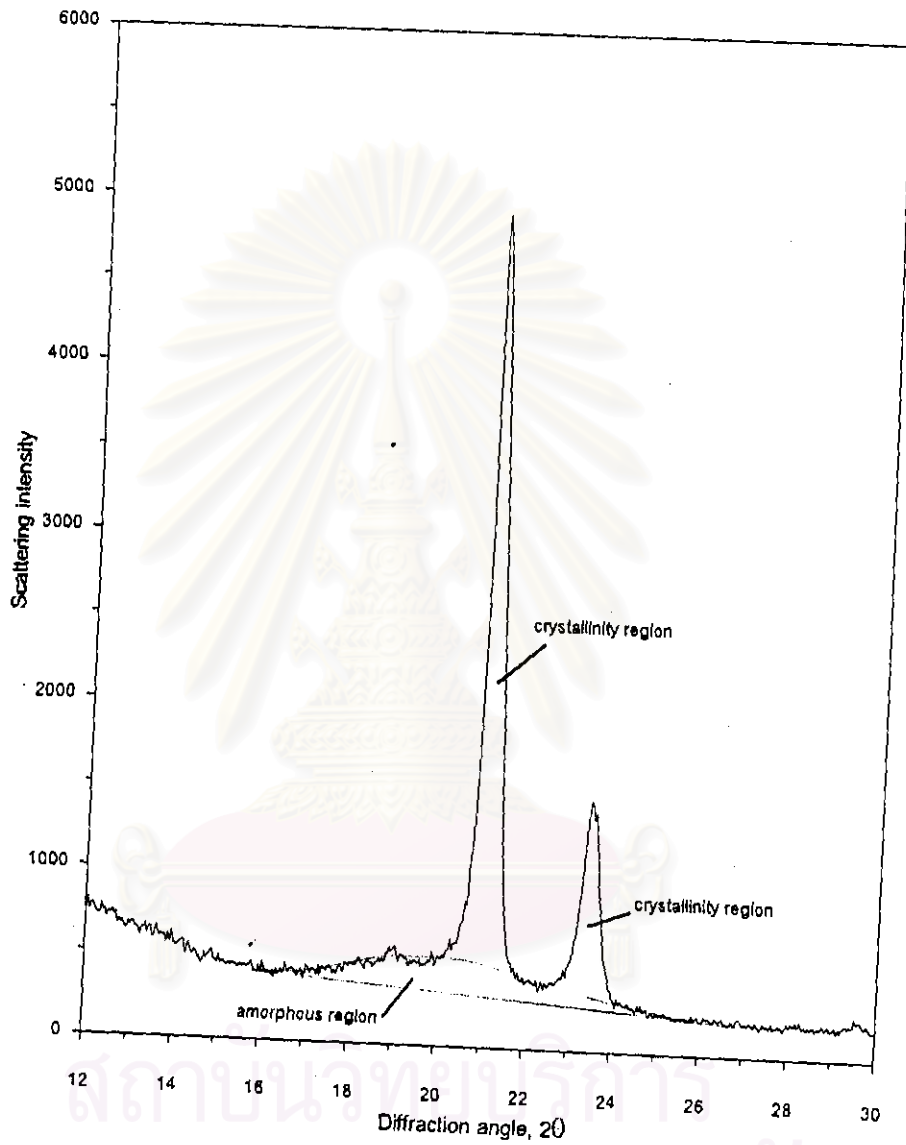


Figure G.11 X-ray diffraction curve of the blended film.

(virgin HDPE 30%, recycled HDPE (film) 30%, recycled HDPE (bottle) 30%, recycled LDPE 10%)

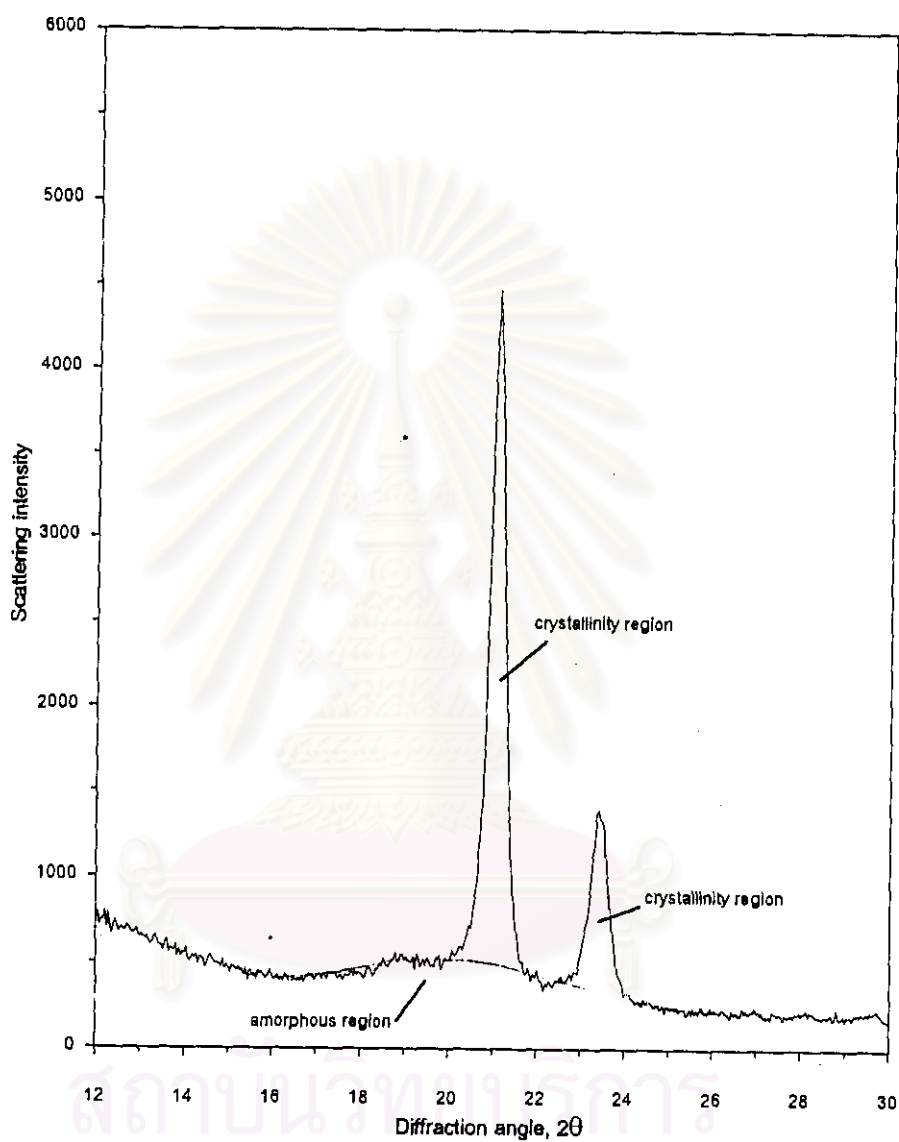


Figure G.12 X-ray diffraction curve of the blended film.

(virgin HDPE 20%, recycled HDPE (film) 30%, recycled HDPE (bottle) 30%, recycled LDPE 20%)

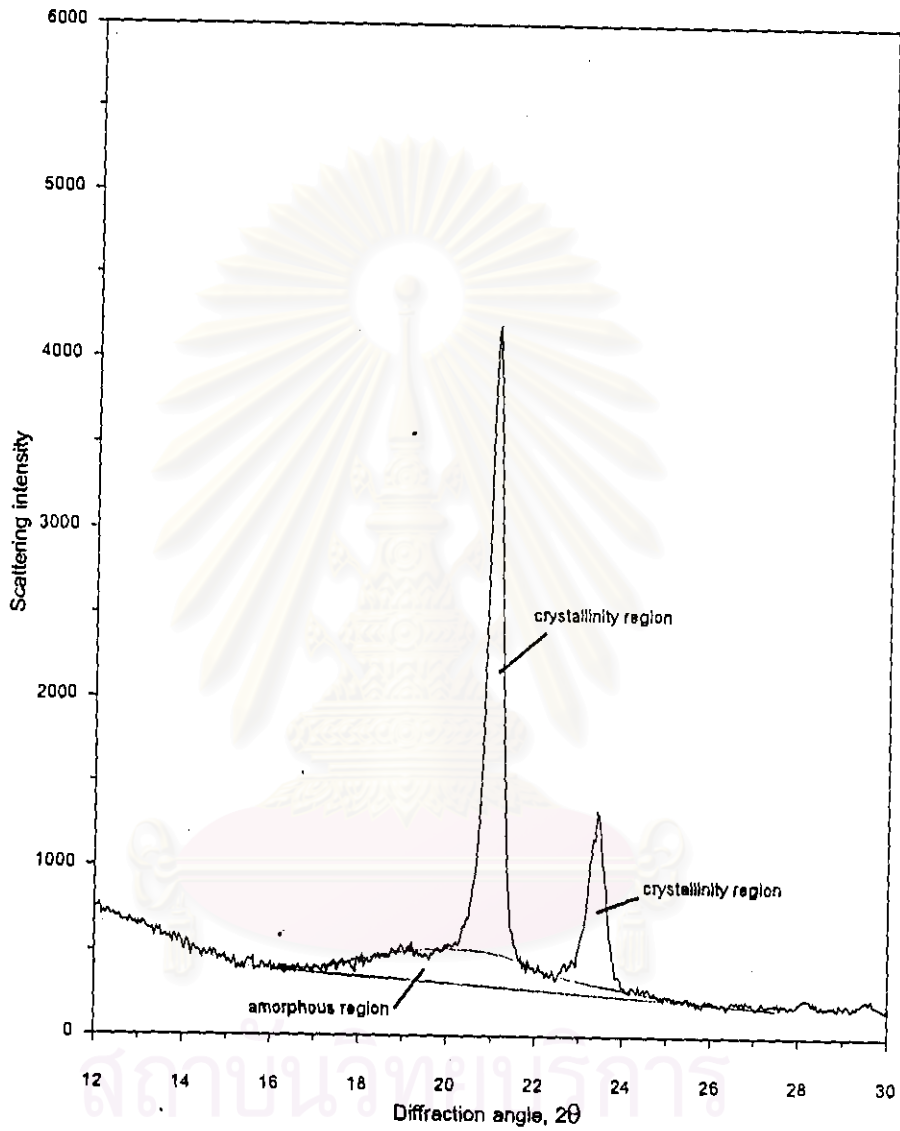


Figure G.13 X-ray diffraction curve of the blended film.

(virgin HDPE 10%, recycled HDPE (film) 30%, recycled HDPE (bottle) 30%, recycled LDPE 30%)

VITA

Mr. Roongroj Phoogpan was born on October 4, 1972 in Phrae. He graduated with a Bachelor Degree of Science (Industrial Chemistry) from Chiangmai University in 1995. He has joined the Product Control, Thai Petrochemical Industry (Public) Co., Ltd. since 1995. In 1998, he was accepted as a graduate student in the Program of Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University. He received a Master's degree of Science in Polymer Science, in April 2000.



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