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APPENDICES

Appendix A 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:

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

$$= \left[\frac{\sum V_i d_i^{M-3}}{\sum V_i d_i^{N-3}} \right]^{1/M-N}$$

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 A1.

Table A1 The mean diameter of TiO₂ particles

Types of TiO ₂	Particle size (μm)			Average	SD
	No.1	No.2	No.3		
Commercial	3.20	2.77	2.90	2.95	0.22
Synthesized	70.86	73.69	74.30	72.95	1.83

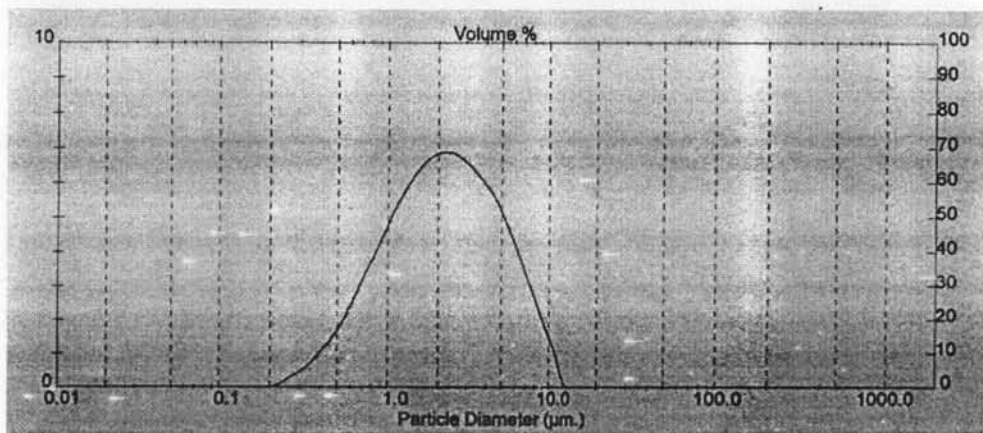
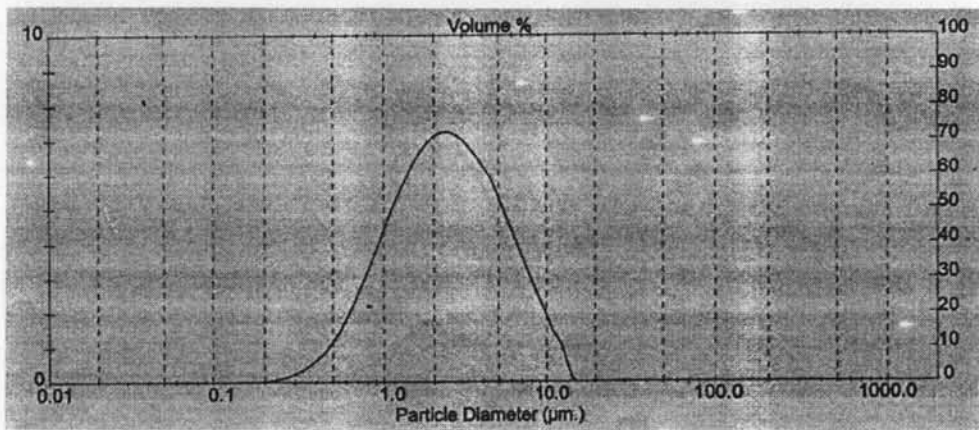
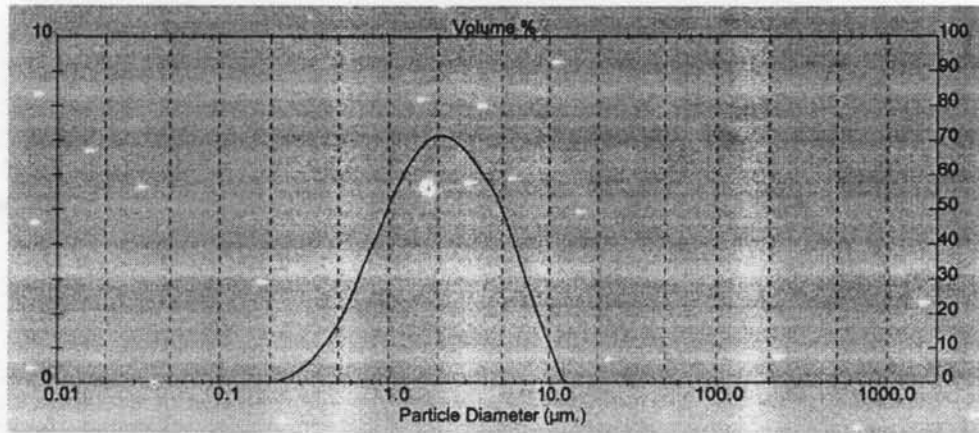
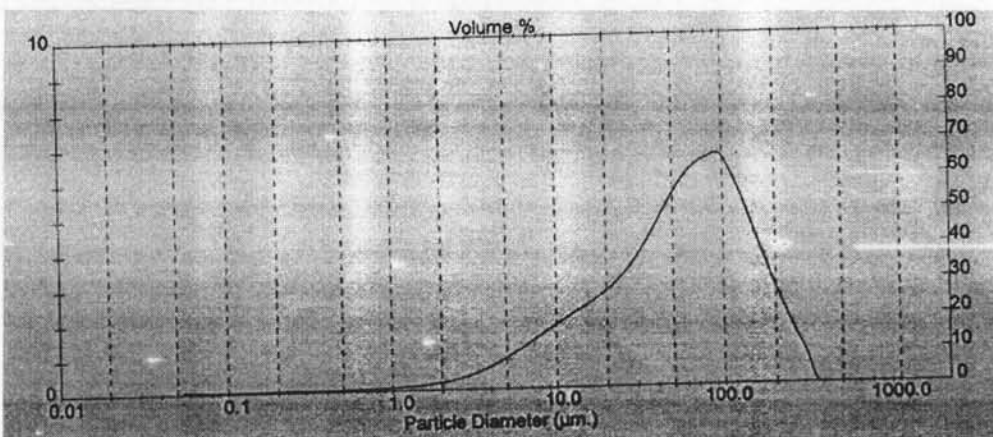
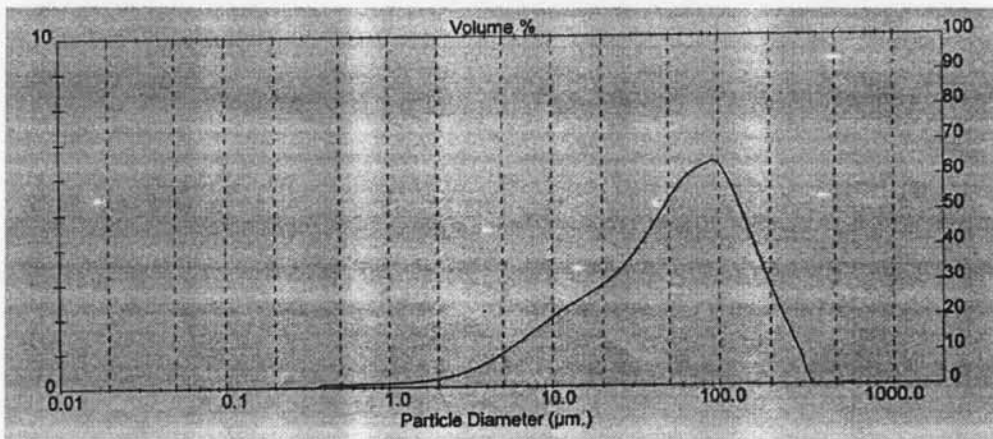
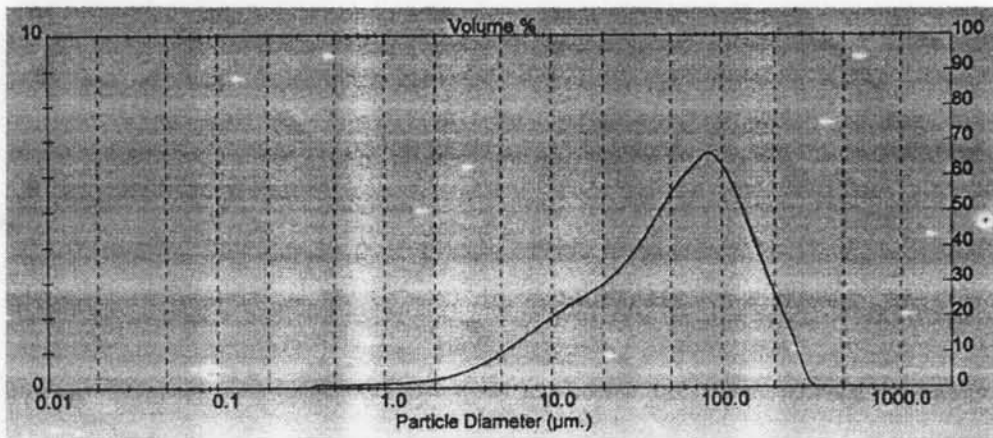
Figure A1 Particle size diameter of commercial TiO₂.

Figure A2 Particle size diameter of synthesized TiO_2 .

Appendix B Thermogravimetric Analysis

Table B1 Degradation temperature of neat PP and PP filled with different amounts of commercial TiO₂

Samples	Degradation temperature (°C)		Average	SD
	No.1	No.2		
PP	341.60	343.20	342.40	1.13
1wt%TiO ₂	356.70	354.20	355.45	1.76
2wt%TiO ₂	373.70	370.30	372.00	2.40
3wt%TiO ₂	373.80	372.10	372.95	1.20
4wt%TiO ₂	374.60	374.30	374.45	0.21
5wt%TiO ₂	379.90	377.90	378.90	1.41
10wt%TiO ₂	373.50	375.20	374.35	1.20

Table B2 Degradation temperature of neat PP and PP filled with different amounts of synthesized TiO₂

Samples	Degradation temperature (°C)		Average	SD
	No.1	No.2		
PP	341.60	343.20	342.40	1.13
1wt%TiO ₂	350.70	349.00	349.85	1.20
3wt%TiO ₂	357.70	358.20	357.95	0.35
5wt%TiO ₂	359.6	361.2	360.4	1.13

Appendix C Mechanical Properties

Table C1 Tensile strength data of neat PP and PP filled with different amounts of commercial TiO₂

No.	PP	1wt%TiO ₂	2wt%TiO ₂	3wt%TiO ₂	4wt%TiO ₂	5wt%TiO ₂	10wt%TiO ₂
1	32.8	32.8	33.6	31.1	31.6	32.2	28.6
2	33.6	32.3	33.0	32.1	31.4	32.2	27.2
3	33.2	31.0	32.6	31.1	31.4	33.2	27.4
4	33.1	33.3	33.5	31.5	31.7	33.3	27.5
5	32.9	31.2	32.6	32.4	31.6	32.4	27.9
Avg (Mpa)	33.1	32.1	33.1	31.6	31.5	32.7	27.7
SD	0.3	0.9	0.4	0.5	0.1	0.5	0.5

Table C2 Percentage of elongation data of neat PP and PP filled with different amounts of commercial TiO₂

No.	PP	1wt%TiO ₂	2wt%TiO ₂	3wt%TiO ₂	4wt%TiO ₂	5wt%TiO ₂	10wt%TiO ₂
1	9.6	8.9	9.0	8.7	8.1	7.4	6.9
2	9.5	9.2	8.7	8.5	8.3	7.7	6.6
3	9.7	9.1	8.8	8.3	8.1	7.8	6.6
4	9.6	9.3	8.3	8.2	8.0	7.3	6.6
5	9.3	9.3	8.9	8.4	8.0	7.6	6.8
Avg (Mpa)	9.6	9.2	8.7	8.4	8.1	7.5	6.7
SD	0.1	0.1	0.2	0.1	0.1	0.2	0.1

Table C3 Young's modulus data of neat PP and PP filled with different amounts of commercial TiO₂

No.	PP	1wt%TiO ₂	2wt%TiO ₂	3wt%TiO ₂	4wt%TiO ₂	5wt%TiO ₂	10wt%TiO ₂
1	1239	1249	1297	1289	1356	1692	2984
2	1322	1276	1379	1285	1356	1495	2851
3	1231	1269	1322	1325	1320	1520	2872
4	1394	1257	1284	1320	1335	1534	3010
5	1277	1230	1307	1235	1285	1528	2785
Avg (Mpa)	1293	1256	1318	1291	1330	1554	2900
SD	67	17	36	35	29	78	94

Table C4 Tensile strength data of neat PP and PP filled with different amounts of synthesized TiO₂

No.	PP	1wt%TiO ₂	3wt%TiO ₂	5wt%TiO ₂
1	32.8	32.1	31.6	31.4
2	33.6	32.5	32.8	31.0
3	33.2	31.3	31.7	31.2
4	33.1	32.6	32.5	31.3
5	32.9	31.0	32.5	31.9
Avg (Mpa)	33.1	31.9	32.2	31.4
SD	0.3	0.7	0.5	0.3

Table C5 Percentage of elongation data of neat PP and PP filled with different amounts of synthesized TiO₂

No.	PP	1wt%TiO ₂	3wt%TiO ₂	5wt%TiO ₂
1	9.6	9.0	8.5	8.5
2	9.5	9.0	8.7	8.6
3	9.7	8.8	8.5	8.5
4	9.6	8.9	8.7	8.1
5	9.3	8.8	8.7	8.4
Avg (Mpa)	9.6	8.9	8.6	8.4
SD	0.1	0.1	0.1	0.2

Table C6 Young's modulus data of neat PP and PP filled with different amounts of synthesized TiO₂

No.	PP	1wt%TiO ₂	3wt%TiO ₂	5wt%TiO ₂
1	1239	1186	1275	1270
2	1322	1320	1244	1229
3	1231	1229	1247	1256
4	1394	1224	1251	1242
5	1277	1190	1211	1212
Avg (Mpa)	1293	1230	1246	1242
SD	67	54	22	22

Table C7 Impact strength data of neat PP and PP filled with different amounts of commercial TiO₂

No.	PP	1wt%TiO ₂	2wt%TiO ₂	3wt%TiO ₂	4wt%TiO ₂	5wt%TiO ₂	10wt%TiO ₂
1	21.7	21.6	22.7	20.2	20.1	21.4	22.4
2	20.6	24.4	21.5	22.9	21.5	22.4	20.9
3	19.2	20.0	24.5	24.6	19.2	19.4	21.4
4	23.4	20.2	25.2	22.3	21.1	19.6	20.2
5	23.3	20.9	22.5	24.4	22.9	23.2	19.5
Avg (J/m)	20.9	21.4	23.3	22.8	20.9	21.2	20.8
SD	1.1	1.7	1.5	1.8	1.4	1.6	1.1

Table C8 Impact strength data of neat PP and PP filled with different amounts of synthesized TiO₂

No.	PP	1wt%TiO ₂	3wt%TiO ₂	5wt%TiO ₂
1	21.7	19.2	21.5	21.4
2	20.6	20.8	22.9	22.4
3	19.2	20.5	19.3	22.9
4	23.4	21.2	20.4	21.2
5	23.3	20.1	22.5	20.5
Avg (J/m)	20.9	20.3	21.3	21.6
SD	1.1	0.7	1.4	0.9

Appendix D FTIR Analysis

Figure D1 FTIR spectrum of commercial TiO_2 .

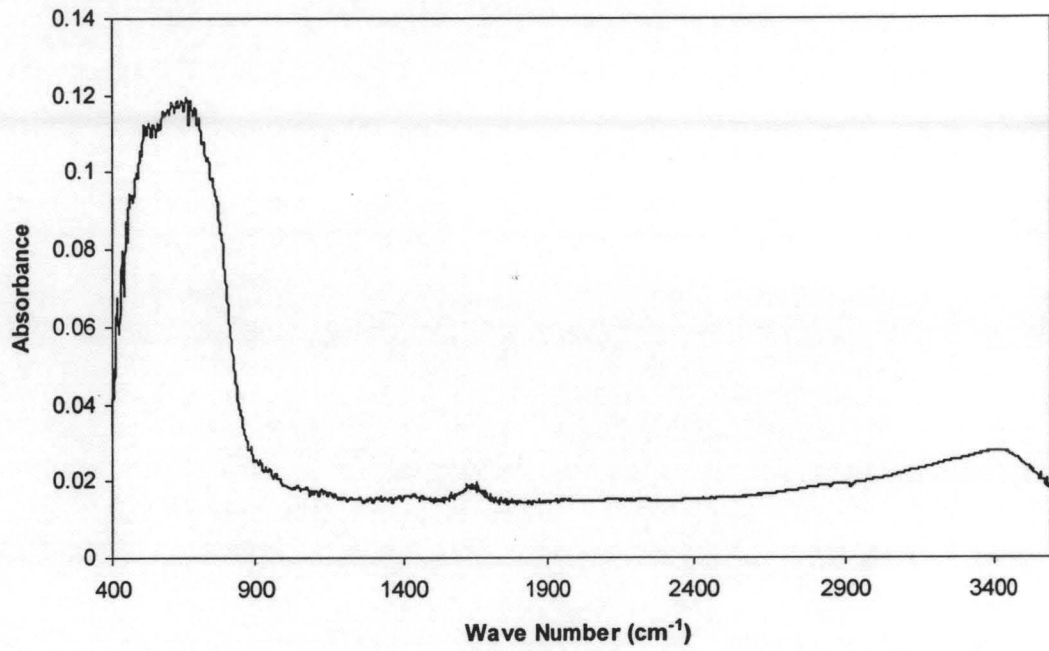


Figure D2 FTIR spectrum of synthesized TiO_2 .

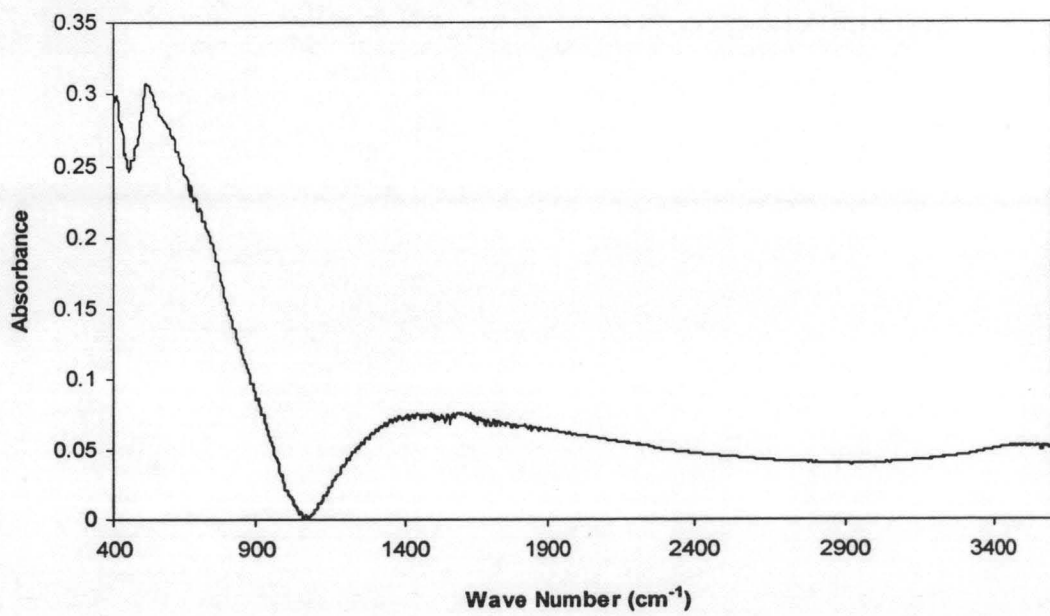


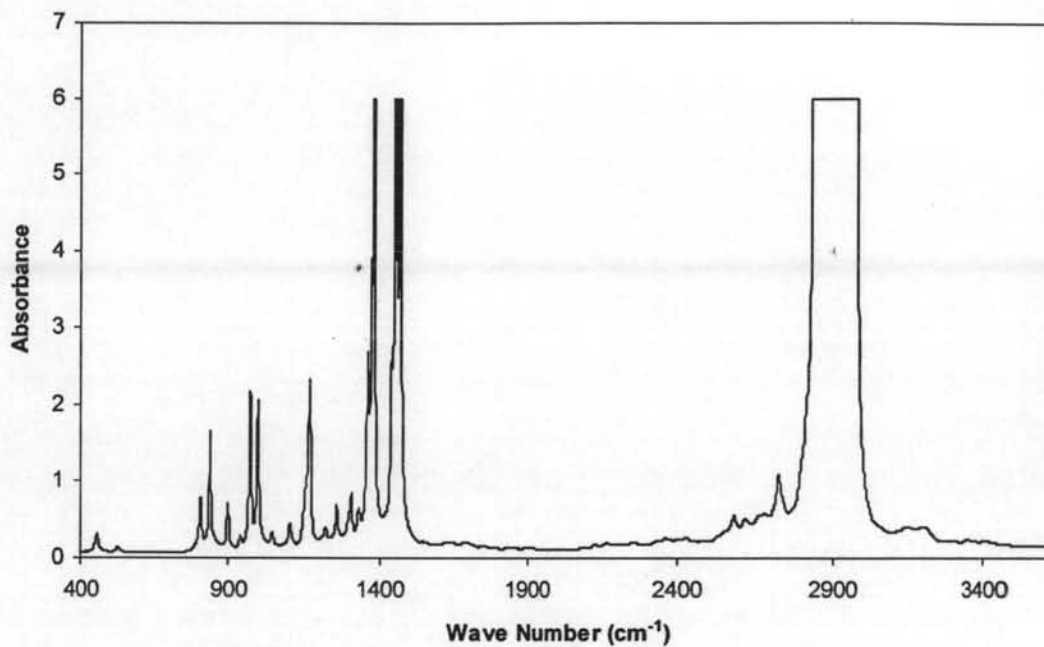
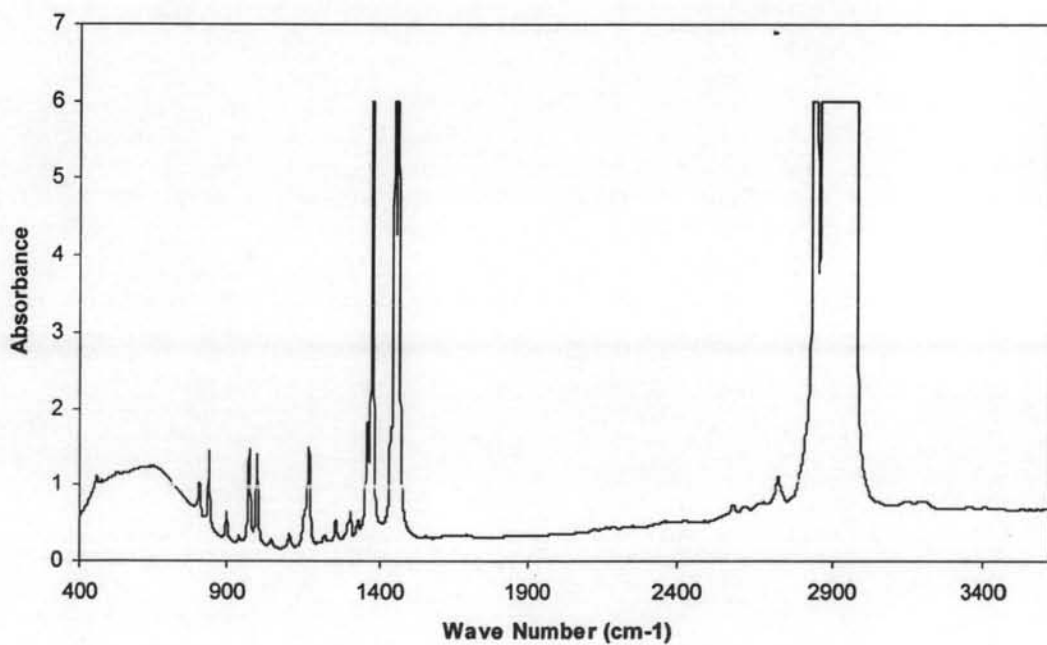
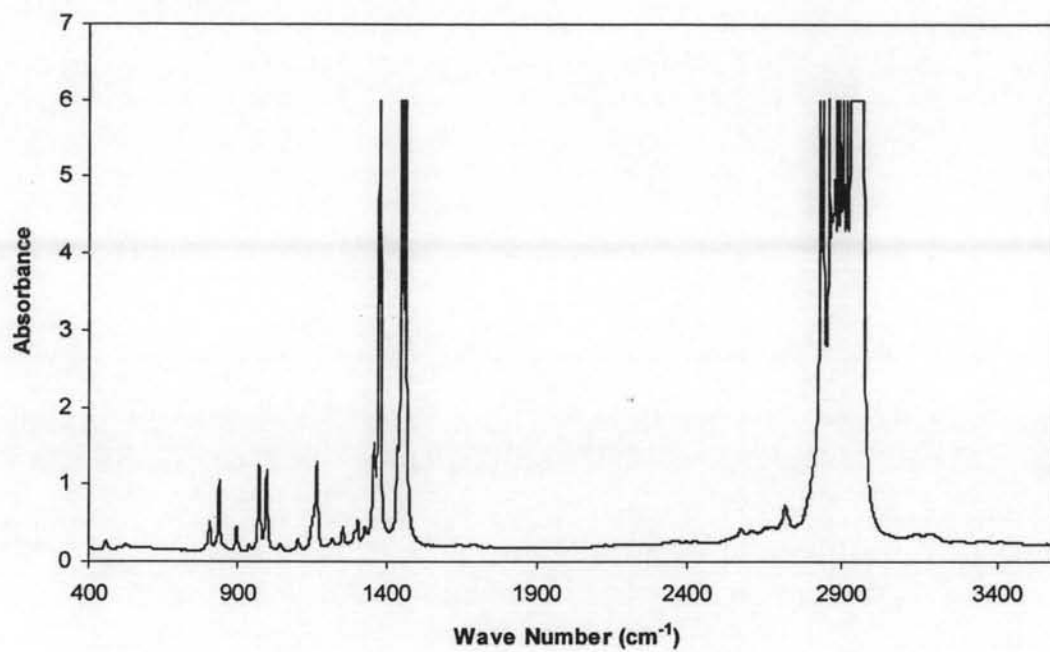
Figure D3 FTIR spectrum of PP film.**Figure D4** FTIR spectrum of PP with commercial TiO_2 composite film.

Figure D5 FTIR spectrum of PP with synthesized TiO₂ composite film.



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