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APPENDICES

Appendix A

Interlayer Spacing Calculation

The interlayer spacing of layered silicates in nylon 6/clay nanocomposite films were calculated by Bragg's law equation as shown below.

$$n\lambda = 2d\sin\theta$$

Where n = integer

λ = wavelength, 1.541°A

d = interlayer spacing between diffractional lattice planes

θ = diffraction angle

Pristine clay, organoclay powder and nylon 6/clay nanocomposite films were measured diffraction angle by means of XRD. For example, the diffraction peak (2θ) of pristine clay was 7.15° which we can calculate interlayer spacing of interlayer spacing showing as follow.

$$(1)(1.541) = 2d \sin (7.15/2)$$

$$d = 12.3^{o}A$$

$$d = 1.23 \text{ nm}$$

Appendix B

Determination of Surfactant Loading

Surfactant loading that was added into the pristine clay to convert its surface of layered silicate to be organophilic clay was calculated as shown below

$$g_{surf} = ((CEC) \times (Conc.) \times (Mw) \times (Kg_{Clay})) / (\%assay)$$

Where g_{surf} = surfactant loading (g)

CEC = cation exchange capacity of untreated clay (meq/g_{clay})

Conc = concentration of surfactant ($mmol_{surf}$)

Mw = molecular weight of surfactant (g_{surf}/mol_{surf})

Kg_{Clay} = weight of untreated clay (kg)

% assay = effectiveness of surfactant

For example, preparation of M_3T organoclay at 1.5 CEC by using 400 g of clay (CEC of sodium bentonite = 90meq/100g of clay)

$$\text{Surfactant loading} = (0.9 \times 1.5 \times 347.5 \times 0.4)/0.5$$

$$= 375.3 \text{ g}$$

Appendix C

Table C.1: Diffraction peak and interlayer spacing of pristine clay, organoclay and nylon 6/clay nanocomposite films corresponding to (xyz) plane.

Sample	2θ (°)	Interlayer spacing (nm.)
Pristine clay	7.15 (001)	1.23 (001)
M_3T Organoclay	1.67 (001) 3.31 (001) 4.65 (001)	5.27 (001) 2.67 (001) 1.90 (001)
1 wt% M_3T nanocomposite	1.96 (001)	4.51 (001)
3 wt% M_3T nanocomposite	2.02 (001)	4.38 (001)
5 wt% M_3T nanocomposite	2.46 (001)	3.58 (001)
7 wt% M_3T nanocomposite	2.60 (001)	3.40 (001)
$M_2(HT)_2$ Organoclay	2.45 (001) 4.88 (002) 7.36 (003)	3.59 (001) 1.81 (002) 1.20 (003)
1 wt% $M_2(HT)_2$ nanocomposite	2.00 (001) 4.59 (002)	4.40 (001) 1.92 (002)
3 wt% $M_2(HT)_2$ nanocomposite	2.33 (001) 4.57 (002)	3.79 (001) 1.93 (002)
5 wt% $M_2(HT)_2$ nanocomposite	2.35 (001) 4.63 (002)	3.75 (001) 1.90 (002)
7 wt% $M_2(HT)_2$ nanocomposite	2.34 (001) 4.62 (002)	3.77 (001) 1.91(002)

Appendix D

Table D.1: Inorganic content of pristine clay and two organoclays.

Sample	Inorganic content (wt %)
Pristine clay	86.54
M_3T Organoclay	37.97
$M_2(HT)_2$ Organoclay	49.67

Appendix E

Table E.1: Melting (T_m) and crystallization temperature (T_c) of nylon 6/clay nanocomposite films at different organoclay loading.

Samples	Melting temperature, T_m (° C)	Crystallization temperature, T_c (° C)
Neat nylon 6	221.21[1]	186.15
1 wt% M_3T nanocomposite	210.66[2] 221.13[1]	194.82
3 wt% M_3T nanocomposite	209.44[2] 220.38[1]	194.84
5 wt% M_3T nanocomposite	209.56[2] 219.89[1]	197.10
7 wt% M_3T nanocomposite	209.56[2] 219.28[1]	194.97
1 wt% $M_2(HT)_2$nanocomposite	210.17[2] 220.19[1]	192.54
3 wt% $M_2(HT)_2$nanocomposite	209.86[2] 219.59[1]	192.24
5 wt% $M_2(HT)_2$nanocomposite	209.86[2] 220.19[1]	192.54
7 wt% $M_2(HT)_2$nanocomposite	208.95[2] 219.97[1]	192.88

[1]is donated as α-crystallinity phase of nylon 6 matrix.

[2]is donated as γ-crystallinity phase of nylon 6 matrix.

Appendix F

Table F.1: Inorganic contents of nylon 6/clay nanocomposite films at different organoclay loading.

Sample	Inorganic content (wt%)
1 wt% M_3T nanocomposite	0.54
3 wt% M_3T nanocomposite	1.69
5 wt% M_3T nanocomposite	2.16
7 wt% M_3T nanocomposite	3.88
1 wt% $M_2(HT)_2$ nanocomposite	0.38
3 wt% $M_2(HT)_2$ nanocomposite	1.10
5 wt% $M_2(HT)_2$ nanocomposite	1.83
7 wt% $M_2(HT)_2$ nanocomposite	3.16

Appendix G

Raw Data of Mechanical Properties and Oxygen Permeability of Nylon 6/Clay Nanocomposite Films

Table G.1: Mechanical properties in machinery direction of M_3T nanocomposite films at 1wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	499.87	27.62	105.72
2	582.84	28.65	121.01
3	545.45	28.73	101.29
4	565.05	31.62	133.89
5	601.98	30.23	122.21
6	499.23	28.03	123.12
7	564.94	30.40	121.55
8	502.43	30.58	100.59
9	538.82	30.29	128.92
10	536.57	29.56	104.56
11	491.72	29.73	116.89
12	521.63	26.01	127.45
13	559.43	31.01	115.83
14	518.22	32.64	107.46
15	568.34	24.44	118.12
16	581.67	28.57	115.83
17	511.14	32.01	123.23
18	540.84	28.76	122.20
19	560.24	31.78	126.18
20	523.71	31.06	103.54
21	562.31	30.79	91.67
22	549.91	29.65	110.21
23	572.53	30.00	83.96
24	563.99	30.78	94.79
25	530.80	28.21	101.96
Mean	**543.75**	**29.65**	**112.89**
SD	**29.71**	**1.88**	**12.81**

Table G.2: Mechanical properties in machinery direction of M_3T nanocomposite films at 3 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	687.72	30.22	91.61
2	709.62	30.62	94.17
3	706.29	32.05	103.33
4	689.85	31.32	64.09
5	748.52	34.13	105.83
6	756.01	30.66	78.13
7	739.92	33.46	64.71
8	797.84	32.23	101.04
9	733.24	32.70	106.87
10	684.81	29.67	88.54
11	640.99	34.42	88.25
12	735.05	34.29	93.33
13	674.39	29.47	96.46
14	647.42	30.16	104.30
15	705.06	33.16	102.71
16	724.24	30.79	97.45
17	663.22	31.50	93.12
18	713.67	30.50	88.43
19	722.31	30.78	71.67
20	746.62	29.45	92.59
21	713.94	31.70	87.56
22	717.84	30.89	72.71
23	679.64	32.01	77.71
24	697.05	31.56	80.62
25	785.20	30.69	96.46
Mean	**712.82**	**31.54**	**89.67**
SD	**38.42**	**1.47**	**12.46**

Table G.3: Mechanical properties in machinery direction of M_3T nanocomposite films at 5 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	892.85	30.83	76.98
2	842.79	30.44	99.79
3	904.27	31.04	95.17
4	870.41	31.30	82.92
5	858.61	30.01	73.75
6	957.43	35.61	91.46
7	866.15	30.86	93.96
8	883.89	32.07	91.20
9	917.88	33.35	67.17
10	817.00	34.74	89.17
11	909.33	32.87	71.88
12	803.08	33.42	74.99
13	842.80	31.03	61.67
14	860.72	33.03	95.63
15	851.92	32.75	109.79
16	907.04	31.00	94.50
17	862.59	32.64	77.80
18	875.54	34.88	72.85
19	801.73	35.59	88.13
20	878.00	32.85	67.41
21	847.38	31.57	105.42
22	875.74	30.39	80.38
23	807.55	31.59	103.89
24	826.73	33.61	90.41
25	951.29	35.97	99.58
Mean	**868.51**	**32.54**	**86.24**
SD	**41.71**	**1.78**	**13.17**

Table G.4: Mechanical properties in machinery direction of M_3T nanocomposite films at 7 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	894.33	32.55	80.21
2	906.84	34.70	66.84
3	946.56	35.98	85.42
4	936.79	32.13	72.71
5	910.05	32.80	85.42
6	955.32	32.75	83.12
7	872.96	32.82	105.11
8	855.06	32.51	81.21
9	903.02	32.11	66.04
10	970.26	34.94	86.25
11	942.28	33.77	89.95
12	1042.86	30.06	61.25
13	926.39	32.97	53.04
14	965.78	32.12	81.35
15	983.39	32.13	76.87
16	943.13	30.03	89.17
17	952.31	31.76	65.57
18	987.61	32.05	95.32
19	914.65	35.04	87.64
20	944.63	34.79	93.96
21	918.37	30.63	64.58
22	972.34	32.49	87.92
23	988.28	34.40	61.87
24	980.79	31.09	96.04
25	863.99	34.74	68.96
Mean	**939.12**	**32.85**	**79.43**
SD	**43.80**	**1.59**	**13.12**

Table G.5: Mechanical properties in machinery direction of $M_2(HT)_2$ nanocomposite films at 1 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	432.00	26.17	112.08
2	411.95	25.84	120.62
3	478.29	28.02	120.00
4	425.67	24.87	115.42
5	477.85	26.43	109.38
6	420.99	26.84	115.74
7	475.06	29.51	126.43
8	440.63	26.75	127.50
9	423.13	25.94	117.29
10	471.86	25.67	102.71
11	391.52	25.36	98.86
12	403.12	25.27	96.34
13	435.43	27.89	131.62
14	392.12	27.25	124.51
15	397.99	30.10	121.87
16	496.28	26.22	103.42
17	495.77	24.99	137.91
18	396.10	25.13	98.13
19	445.80	24.73	128.71
20	483.23	26.99	102.71
21	476.45	24.99	131.88
22	494.40	25.67	122.08
23	455.16	25.43	116.46
24	516.33	26.07	133.54
25	439.31	27.80	112.83
Mean	**447.06**	**26.40**	**117.12**
SD	**37.55**	**1.40**	**11.94**

Table G.6: Mechanical properties in machinery direction of $M_2(HT)_2$ nanocomposite films at 3 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	438.23	23.38	106.85
2	452.51	28.11	112.84
3	461.61	27.33	89.37
4	491.20	25.98	91.87
5	478.43	29.29	105.83
6	432.31	27.92	85.21
7	479.57	28.73	89.12
8	426.28	28.74	139.74
9	485.52	28.06	85.63
10	520.54	30.78	110.42
11	427.90	25.64	82.29
12	424.63	26.39	101.46
13	566.44	27.70	87.50
14	575.70	26.23	80.63
15	418.57	28.39	123.73
16	551.98	24.34	108.96
17	423.32	25.91	105.62
18	473.70	24.97	121.15
19	414.12	27.39	85.67
20	500.98	27.91	106.57
21	399.61	30.12	126.67
22	398.58	28.64	109.17
23	341.23	26.46	99.38
24	370.64	24.06	126.18
25	496.26	26.38	78.25
Mean	**457.99**	**27.15**	**102.40**
SD	**58.33**	**1.86**	**16.69**

Table G.7: Mechanical properties in machinery direction of $M_2(HT)_2$ nanocomposite films at 5 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	461.03	22.23	88.51
2	450.19	20.77	120.35
3	406.04	24.04	96.04
4	395.45	22.00	123.96
5	489.97	23.18	90.83
6	416.01	20.24	104.79
7	451.07	22.04	94.68
8	410.17	22.23	99.72
9	398.24	23.82	98.75
10	489.85	24.42	107.84
11	489.27	19.71	97.83
12	468.52	30.51	115.68
13	485.57	23.08	80.60
14	456.07	24.49	99.37
15	406.36	19.76	94.09
16	375.53	22.86	107.08
17	384.88	21.79	108.96
18	402.34	23.58	111.97
19	408.85	24.29	103.63
20	507.30	23.96	92.29
21	374.08	22.36	101.02
22	390.88	24.40	102.08
23	338.98	25.01	99.14
24	451.07	25.39	102.08
25	459.69	23.35	99.17
Mean	**430.70**	**23.18**	**101.62**
SD	**44.78**	**2.19**	**9.77**

Table G.8: Mechanical properties in machinery direction of $M_2(HT)_2$ nanocomposite films at 7 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	312.98	19.02	132.83
2	350.67	20.64	151.46
3	312.20	20.50	144.58
4	398.47	21.77	146.56
5	358.76	21.09	107.38
6	324.81	20.98	126.04
7	364.45	20.96	144.79
8	415.88	21.78	134.35
9	391.08	21.58	108.53
10	380.72	20.57	110.65
11	406.59	18.73	115.94
12	340.27	22.64	111.27
13	305.68	21.39	103.77
14	308.93	21.35	149.67
15	333.08	21.66	134.79
16	347.27	18.67	143.75
17	340.39	21.13	131.85
18	369.48	19.59	123.54
19	435.96	20.32	148.54
20	489.56	22.38	121.46
21	466.75	21.86	114.79
22	435.22	23.46	133.54
23	450.11	22.38	137.08
24	371.00	21.84	118.96
25	462.53	21.76	107.83
Mean	**378.91**	**21.12**	**128.16**
SD	**54.29**	**1.19**	**15.38**

Table G.9: Mechanical properties in machinery direction of neat nylon 6 films.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	339.49	21.22	156.87
2	373.74	20.97	176.61
3	351.65	19.81	126.67
4	321.66	20.85	138.85
5	344.01	20.25	175.38
6	360.17	21.74	171.18
7	331.36	21.63	173.54
8	394.29	21.65	174.96
9	353.23	20.61	155.15
10	402.73	22.34	189.38
11	315.89	22.27	172.71
12	307.44	20.40	189.06
13	347.19	21.38	166.57
14	296.09	22.64	155.98
15	387.60	18.77	168.54
16	273.60	20.65	182.65
17	391.98	21.68	159.78
18	343.72	20.78	165.42
19	408.74	21.53	162.65
20	387.73	20.76	163.02
21	374.68	20.98	162.66
22	377.94	19.88	155.59
23	335.78	21.78	158.54
24	313.51	20.33	121.85
25	347.19	20.80	170.83
Mean	**351.26**	**21.03**	**163.78**
SD	**35.02**	**0.88**	**16.38**

Table G.10: Mechanical properties in transverse direction of M_3T nanocomposite films at 1 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	341.56	22.17	203.34
2	362.98	25.70	187.80
3	351.01	24.56	204.87
4	381.42	24.70	179.93
5	344.33	26.46	235.73
6	337.87	25.30	215.87
7	387.42	25.36	206.00
8	343.01	21.78	221.37
9	348.29	26.43	249.10
10	348.34	26.46	257.10
11	294.70	21.55	245.03
12	296.39	21.78	254.80
13	317.57	25.16	280.77
14	327.60	27.39	240.50
15	304.28	22.28	282.30
16	361.32	24.59	295.03
17	317.08	27.03	276.67
18	323.74	27.88	284.00
19	328.78	24.69	186.50
20	356.41	23.96	241.67
21	367.81	25.71	245.83
22	380.75	26.52	250.00
23	344.72	24.38	245.83
24	408.78	25.44	266.67
25	334.51	26.98	206.93
Mean	**344.43**	**24.97**	**238.55**
SD	**28.17**	**1.85**	**33.03**

Table G.11: Mechanical properties in transverse direction of M_3T nanocomposite films at 3 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	534.41	27.64	203.60
2	541.23	24.29	142.30
3	564.05	24.51	230.83
4	579.51	26.21	214.80
5	536.99	24.86	195.03
6	561.95	24.88	180.47
7	573.56	24.72	211.37
8	550.95	25.55	198.13
9	543.88	27.64	167.50
10	650.34	30.65	190.35
11	704.89	26.78	233.80
12	538.91	27.40	176.40
13	604.39	27.64	180.34
14	634.18	22.52	140.53
15	505.91	24.06	241.67
16	522.59	23.69	187.30
17	517.68	23.83	237.87
18	575.23	26.90	234.23
19	638.91	29.33	234.30
20	567.91	21.26	170.70
21	560.80	26.40	148.33
22	567.35	25.79	179.17
23	608.35	27.98	162.50
24	531.62	26.34	162.50
25	558.76	24.77	185.50
Mean	**570.97**	**25.83**	**192.38**
SD	**46.71**	**2.11**	**30.98**

Table G.12: Mechanical properties in transverse direction of M_3T nanocomposite films at 5 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	659.31	27.17	140.70
2	585.83	25.31	210.07
3	574.19	27.31	192.60
4	603.42	25.97	220.97
5	563.42	23.49	146.03
6	629.33	26.02	172.50
7	657.33	29.32	206.50
8	578.09	24.08	187.17
9	580.70	27.05	206.93
10	616.92	32.37	186.83
11	605.68	31.69	200.63
12	649.31	33.73	174.20
13	678.71	23.20	153.23
14	623.17	22.52	150.73
15	651.40	22.22	186.17
16	641.23	26.31	123.20
17	609.19	31.88	177.70
18	572.43	32.47	158.83
19	623.40	31.26	167.27
20	602.98	31.83	182.43
21	536.02	32.95	171.40
22	528.70	32.60	186.57
23	509.17	30.15	212.57
24	584.76	32.08	203.37
25	575.86	26.39	199.13
Mean	**601.62**	**28.37**	**180.71**
SD	**42.88**	**3.74**	**25.01**

Table G.13: Mechanical properties in transverse direction of M_3T nanocomposite films at 7 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	616.40	30.24	199.70
2	576.95	28.72	147.27
3	629.96	29.96	193.03
4	617.09	27.10	124.57
5	597.76	27.03	134.67
6	609.06	29.43	154.50
7	642.38	26.08	187.23
8	619.21	26.43	194.43
9	632.97	27.54	204.17
10	705.29	24.17	184.13
11	548.26	25.69	244.87
12	652.10	25.57	216.23
13	520.32	24.03	96.37
14	559.00	23.49	237.23
15	520.68	27.00	213.87
16	500.22	33.54	170.20
17	565.49	25.85	229.07
18	547.35	26.84	151.83
19	584.08	25.77	143.77
20	664.43	32.38	157.87
21	601.29	28.68	145.83
22	621.34	27.75	169.75
23	586.59	22.39	180.53
24	571.39	26.98	181.23
25	584.08	28.83	194.83
Mean	**594.95**	**27.26**	**178.29**
SD	**48.10**	**2.61**	**36.36**

Table G.14: Mechanical properties in transverse direction of $M_2(HT)_2$ nanocomposite films at 1 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	371.58	24.33	205.63
2	336.66	21.76	203.90
3	354.67	24.61	236.47
4	305.84	23.38	254.48
5	331.59	21.58	250.93
6	325.25	24.84	235.13
7	348.39	23.60	206.73
8	330.47	25.27	242.17
9	340.39	24.16	238.17
10	281.93	26.33	258.27
11	312.43	26.33	243.06
12	303.05	23.31	271.44
13	402.33	25.76	238.73
14	405.88	21.83	240.12
15	346.11	24.04	235.73
16	341.31	23.67	235.46
17	407.29	20.83	273.87
18	320.79	24.38	260.70
19	313.19	26.16	223.51
20	403.84	25.54	226.98
21	320.73	22.95	252.50
22	318.79	23.83	247.30
23	305.08	21.79	244.17
24	312.65	24.03	279.17
25	359.92	22.52	228.00
Mean	**340.01**	**23.87**	**241.31**
SD	**35.05**	**1.56**	**19.60**

Table G.15: Mechanical properties in transverse direction of $M_2(HT)_2$ nanocomposite films at 3 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	351.89	25.83	187.47
2	334.21	23.22	193.70
3	344.75	25.20	224.63
4	333.23	24.66	224.50
5	357.22	25.64	206.90
6	356.67	24.46	177.97
7	352.20	25.35	190.27
8	428.89	24.83	180.40
9	365.73	23.91	212.27
10	415.15	23.50	201.40
11	396.88	26.16	183.20
12	308.37	22.79	206.93
13	372.37	25.31	250.83
14	411.43	27.31	191.20
15	383.69	28.55	194.80
16	328.64	27.58	257.03
17	329.06	20.83	208.77
18	326.15	24.73	166.73
19	370.84	24.78	204.17
20	400.89	24.86	154.17
21	371.35	25.08	191.67
22	361.80	23.23	192.50
23	397.43	24.57	188.33
24	411.83	24.97	170.83
25	347.64	23.55	217.17
Mean	**366.33**	**24.84**	**199.11**
SD	**32.41**	**1.60**	**23.74**

Table G.16: Mechanical properties in transverse direction of $M_2(HT)_2$ nanocomposite films at 5 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	286.96	22.81	240.23
2	325.49	19.92	245.50
3	359.38	21.99	263.17
4	275.26	21.61	245.17
5	322.90	23.28	233.00
6	416.06	22.21	228.13
7	367.14	21.50	222.57
8	343.64	20.01	233.83
9	333.34	20.86	240.87
10	350.68	21.78	235.42
11	348.74	23.08	208.16
12	260.79	22.05	219.57
13	358.42	21.36	237.05
14	325.62	20.79	244.51
15	284.75	22.22	273.00
16	389.58	23.69	236.93
17	342.61	21.79	263.93
18	340.87	24.08	230.68
19	339.84	20.99	245.67
20	329.38	22.64	212.50
21	351.49	23.78	232.50
22	347.13	21.81	237.50
23	338.72	21.79	245.83
24	342.52	23.26	205.84
25	351.73	22.76	239.10
Mean	**337.32**	**22.08**	**236.83**
SD	**33.70**	**1.11**	**16.03**

Table G.17: Mechanical properties in transverse direction of $M_2(HT)_2$ nanocomposite films at 7 wt%.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	331.75	21.23	267.40
2	319.59	15.33	247.33
3	339.88	22.72	233.53
4	329.49	23.06	226.77
5	328.38	21.05	259.40
6	365.12	20.26	237.37
7	358.84	19.67	252.43
8	325.58	20.47	249.10
9	341.35	23.00	251.93
10	340.30	20.39	261.70
11	340.33	20.39	221.03
12	349.29	24.05	218.47
13	381.90	25.82	259.12
14	337.07	21.75	250.83
15	415.27	22.39	193.00
16	402.77	24.33	221.87
17	366.13	26.17	216.67
18	269.84	22.38	222.67
19	343.00	24.05	199.37
20	346.30	21.61	196.70
21	340.79	21.79	227.67
22	282.99	23.42	221.43
23	320.84	23.50	216.87
24	334.17	22.75	168.20
25	344.40	20.51	250.57
Mean	**342.22**	**22.08**	**230.86**
SD	**30.68**	**2.22**	**24.73**

Table G.18: Mechanical properties in transverse direction of neat nylon 6 films.

	Tensile modulus (MPa)	Yield strength (MPa)	Elongation at break (%)
1	359.27	20.84	263.30
2	351.60	20.53	264.13
3	324.12	20.23	259.97
4	334.32	19.77	265.53
5	315.75	20.26	264.80
6	334.94	20.75	266.73
7	350.21	21.96	263.87
8	353.77	19.88	265.47
9	336.48	20.18	267.47
10	325.83	20.29	298.03
11	304.71	20.64	264.53
12	339.50	21.71	260.80
13	341.52	19.24	234.29
14	321.16	19.79	210.89
15	373.88	17.85	253.30
16	322.28	19.89	223.60
17	317.09	20.13	259.68
18	324.93	19.04	240.53
19	319.35	20.10	261.55
20	342.56	20.38	220.83
21	338.57	21.01	216.67
22	300.56	19.64	200.00
23	389.65	18.54	212.50
24	349.78	19.86	220.83
25	302.52	18.76	265.40
Mean	**334.97**	**20.05**	**248.99**
SD	**21.46**	**0.91**	**24.43**

Table G.19: Oxygen permeability (cc.mil/(m^2.day.atm)) of nanocomposite films at different M_3T organoclay loading.

Sample no.	Neat nylon 6	1 wt%	3 wt%	5 wt%	7 wt%
1	67.13	69.74	80.50	56.32	55.96
2	77.01	69.07	79.69	49.35	57.05
Mean	**72.07**	**69.41**	**80.09**	**52.84**	**56.50**
SD	**7.00**	**0.47**	**0.58**	**4.93**	**0.77**

Table G.20: Oxygen permeability (cc.mil/(m^2.day.atm)) of nanocomposite films at different $M_2(HT)_2$ organoclay loading.

Sample no.	Neat nylon 6	1 wt%	3 wt%	5 wt%	7 wt%
1	67.13	67.65	76.38	87.91	118.30
2	77.01	74.96	77.66	93.28	108.19
Mean	**72.07**	**71.31**	**77.02**	**90.60**	**113.24**
SD	**7.00**	**5.17**	**0.90**	**3.80**	**7.15**

Table G.21: An area of diffraction peak of XRD (2θ=18-28°) of nylon 6/clay nanocomposite films.

Samples	Area of diffraction peak
Neat nylon 6 film	6.67
1 wt% M_3T nanocomposite film	73.85
3 wt% M_3T nanocomposite film	75.10
5 wt% M_3T nanocomposite film	38.04
7 wt% M_3T nanocomposite film	76.24
1 wt% $M_2(HT)_2$ nanocomposite film	53.18
3 wt% $M_2(HT)_2$ nanocomposite film	64.23
5 wt% $M_2(HT)_2$ nanocomposite film	32.93
7 wt% $M_2(HT)_2$ nanocomposite film	31.25

Appendix H

Determination of degree of crystallinity (DSC experiment)

Besides thermal properties of nanocomposite films such as melting temperature (T_m) and crystallization temperature (T_c), area under DSC heating curve can identify the degree of crystallinity of nanocomposite films. To determine the degree of crystallinity by means of DSC, 100 percent crystallinity was introduced to calculate degree of crystallinity of nanocomposite films. In this study, nanocomposite films had nylon 6 as polymer matrix in this system that 100 percent degree of crystallinity of nylon 6 is 190 J/g. Degree of crystallinity was determined as shown below

$$\text{Degree of crystallinity} = \frac{\text{Area under DSC heating curve} \times 100}{\text{Enthalpy of 100 percent crystallinity}}$$

where $\Delta H\ (100\%\text{crystallinity})_{\text{nylon 6}} = 190$ J/g

The area under diffraction peak and degree of crystallinity of nanocomposite films were summarized in table H.1. For example, the degree of crystallinity of $M_2(HT)_2$ nanocomposite films at 1 wt% organoclay loading as shown in figure 5.8 was determined by using above equation.

$$\text{Degree of crystallinity} = \frac{72.04 \times 100}{190}$$

$$= 37.92$$

Table H.1: Area under DSC heating curve and degree of crystallinity of nanocomposite films.

Samples	Area	Degree of crystallinity
Neat nylon 6	67.20	35.37
1 wt% M_3T nanocomposite film	68.31	35.95
3 wt% M_3T nanocomposite film	63.84	33.60
5 wt% M_3T nanocomposite film	63.90	33.63
7 wt% M_3T nanocomposite film	45.05	23.71
1 wt% $M_2(HT)_2$ nanocomposite film	72.04	37.92
3 wt% $M_2(HT)_2$ nanocomposite film	64.62	34.01
5 wt% $M_2(HT)_2$ nanocomposite film	57.14	30.07
7 wt% $M_2(HT)_2$ nanocomposite film	54.26	28.56

VITA

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