



REFERENCES

- Esumi, K., Watanabe, N., and Megura, K. (1991). Polymerization of styrene adsolubilized in polymerizable surfactant bilayer on alumina. Langmuir, 7(3), 1775-1778.
- Grady, B.P., O'Rear, E.A., Penn, L.S., and Pedicin, A. (1998). Polymerization of styrene-isoprene on glass cloth for use in composite manufacture. Polymer Composites, 19(5), 579-587.
- Harwell, J.H., and O'Rear E.A. (1998). U.S. Patent No. 4770906.
- Jones, F.R. (1994). Handbook of Polymer-Fiber Composites. England: Longman Scientific and Technical.
- Lai, C., Harwell, JH., and O'Rear, E.A. (1995). Formation of poly(tetrafluoroethylene) thin films on alumina by admicellar polymerization. Langmuir, 11(11), 905-911.
- Laing, JZ., and Li, RKY. (2000). Effect of filler content and surface treatment on tensile properties of glass-bead-filled polypropylene composites. Polymer Internations, 49(2), 170-174.
- Lubin, G. (1982). Handbook of Composites. United States of America: A Society of Plastics Engineers Technical Mcnograph.
- Moon, C.K., Lee, J., Cho, H.H., and Kim, K. S. (1992). Effect of diameter and surface treatment of fiber in interfacial shear strength in fiber/epoxy and HDPE. Journal of Applied Polymer Science, 45, 443-450.
- O'Haver, J.H., Harwell, J.H., O'Rear, E.A., Waddell, W.H., Snodgrass, L.J., and Parker, J.R. (1993). Formation of ultrathin polystyrene films in adsorbed surfactant bilayers on silica. Material Research Society Symposium Proceedings, 340, 161-166.
- Rosen, M.J. (1998). Surfactants and Interfacial Phenomena. 2nded. United States of America: John Wiley.
- Sakhalkar, S.S., and Hirt, D.E. (1995). Admicellar polymerization of polystyrene on glass fibers. Langmuir, 11(5), 3369-3373.

Seymour, R.B. (1993). Reinforced Plastics: Properties and Applications. United States of America: ASM International.

Yue, C.Y., and Cheung, W.L. (1992). Interfacial properties of fiber-reinforced composites. Journal of Material Science, 27, 3843-3855.

APPENDICES

Appendix A Pressure Drop of Ethylene during the Adsolubilization and Admicellar Polymerization Process

Table A1 Dissolution of ethylene into water (blank) for the first and second steps.

First step					Second step				
Time (h)	Pressure drop (psi)				Time (h)	Pressure drop (psi)			
	No.1	No.2	No.3	Ave		No.1	No.2	No.3	Ave
0	0	0	0	0.00	0	0	0	0	0.00
1	3	5	4	5.00	1	0	0	0	0.00
2	5	7	6	6.00	2	0	0	0	0.00
3	8	9	7	8.00	3	0	0	0	0.00
4	10	10	10	10.00	4	0	0	0	0.00
5	10	10	10	10.00	5	0	0	0	0.00
6	10	10	10	10.00	6	0	0	0	0.00
7	10	10	10	10.00	7	0	0	0	0.00
8	10	10	10	10.00	8	0	0	0	0.00
9	10	10	10	10.00	9	0	0	0	0.00
10	10	10	10	10.00	10	0	0	0	0.00
11	10	10	10	10.00	11	0	0	0	0.00
12	10	10	10	10.00	12	0	0	0	0.00
13	10	10	10	10.00	13	0	0	0	0.00
14	10	10	10	10.00	14	0	0	0	0.00
15	10	10	10	10.00	15	0	0	0	0.00
16	10	10	10	10.00	16	0	0	0	0.00
17	10	10	10	10.00	17	0	0	0	0.00
18	10	10	10	10.00	18	0	0	0	0.00
20	10	10	10	10.00	20	0	0	0	0.00
21	10	10	10	10.00	21	0	0	0	0.00
22	10	10	10	10.00	22	0	0	0	0.00
23	10	10	10	10.00	23	0	0	0	0.00
24	10	10	10	10.00	24	0	0	0	0.00

Table A2 Ethylene pressure drop for the adsolubilization and admicellar polymerization steps of the system with surfactant at 8.2 mM surfactant concentration and 3:1 initiator to surfactant ratio.

Adsolubilization process					Admicellar polymerization process				
Time (h)	Pressure drop (psi)				Time (h)	Pressure drop (psi)			
	No.1	No.2	No.3	Ave		No.1	No.2	No.3	Ave
0	0	0	0	0.00	0	0	0	0	0.00
1	6	5	6	5.67	1	7	6	5	6.00
2	8	7	8	7.67	2	9	8	9	8.67
3	10	9	9	9.67	3	16	14	13	14.33
4	11	9	10	10.00	4	18	18	18	18.00
5	11	9	10	10.00	5	22	23	21	22.00
6	11	10	11	10.67	6	23	25	23	23.67
7	11	10	11	10.67	7	25	26	24	25.00
8	11	10	11	10.67	8	26	26	25	25.67
9	11	10	11	10.67	9	26	26	25	25.67
10	11	10	11	10.67	10	26	27	26	26.33
11	11	10	11	10.67	11	26	27	26	26.33
12	11	10	11	10.67	12	26	27	26	26.33
13	11	10	11	10.67	13	26	27	26	26.33
14	11	10	11	10.67	14	26	27	26	26.33
15	11	10	11	10.67	15	26	27	26	26.33
16	11	10	11	10.67	16	26	27	26	26.33
17	11	10	11	10.67	17	26	27	26	26.33
18	11	10	11	10.67	18	26	27	26	26.33
20	11	10	11	10.67	20	26	27	26	26.33
21	11	10	11	10.67	21	26	27	26	26.33
22	11	10	11	10.67	22	26	27	26	26.33
23	11	10	11	10.67	23	26	27	26	26.33
24	11	10	11	10.67	24	26	27	26	26.33

Table A3 Ethylene pressure drop for the adsolubilization and admicellar polymerization steps of the system without surfactant at 8.2 mM surfactant concentration and 3:1 initiator to surfactant ratio.

Adsolubilization process					Admicellar polymerization process				
Time (h)	Pressure drop (psi)				Time (h)	Pressure drop (psi)			
	No.1	No.2	No.3	Ave		No.1	No.2	No.3	Ave
0	0	0	0	0.00	0	0	0	0	0.00
1	4	6	3	4.33	1	8	7	5	6.67
2	7	8	5	6.67	2	14	10	10	11.33
3	8	9	8	8.33	3	16	15	13	14.67
4	10	10	9	9.67	4	19	19	18	18.67
5	10	10	10	10.00	5	22	23	22	22.33
6	10	10	10	10.00	6	23	24	24	23.67
7	10	10	10	10.00	7	24	24	24	24.00
8	10	10	10	10.00	8	24	24	24	24.00
9	10	10	10	10.00	9	24	24	24	24.00
10	10	10	10	10.00	10	24	24	24	24.00
11	10	10	10	10.00	11	24	24	24	24.00
12	10	10	10	10.00	12	24	24	24	24.00
13	10	10	10	10.00	13	24	24	24	24.00
14	10	10	10	10.00	14	24	24	24	24.00
15	10	10	10	10.00	15	24	24	24	24.00
16	10	10	10	10.00	16	24	24	24	24.00
17	10	10	10	10.00	17	24	24	24	24.00
18	10	10	10	10.00	18	24	24	24	24.00
20	10	10	10	10.00	20	24	24	24	24.00
21	10	10	10	10.00	21	24	24	24	24.00
22	10	10	10	10.00	22	24	24	24	24.00
23	10	10	10	10.00	23	24	24	24	24.00
24	10	10	10	10.00	24	24	24	24	24.00

Table A4 Ethylene pressure drop for the adsolubilization and admicellar polymerization steps of the system with surfactant at 8.2 mM surfactant concentration and 6:1 initiator to surfactant ratio.

Adsolubilization process					Admicellar polymerization process				
Time (h)	Pressure drop (psi)				Time (h)	Pressure drop (psi)			
	No.1	No.2	No.3	Ave		No.1	No.2	No.3	Ave
0	0	0	0	0.00	0	0	0	0	0.00
1	5	5	4	4.67	1	10	10	8	9.33
2	7	7	6	6.67	2	17	17	14	16.00
3	8	9	7	8.00	3	24	25	23	24.00
4	10	11	8	9.67	4	28	29	28	28.33
5	10	11	10	10.33	5	31	34	32	32.33
6	11	11	10	10.67	6	33	37	36	35.33
7	11	11	10	10.67	7	37	41	40	39.33
8	11	11	10	10.67	8	40	42	42	41.33
9	11	11	10	10.67	9	42	42	42	42.00
10	11	11	10	10.67	10	43	42	42	42.33
11	11	11	10	10.67	11	43	43	43	43.00
12	11	11	10	10.67	12	44	43	43	43.33
13	11	11	10	10.67	13	44	43	43	43.33
14	11	11	10	10.67	14	44	43	44	43.67
15	11	11	10	10.67	15	44	43	44	43.67
16	11	11	10	10.67	16	44	43	44	43.67
17	11	11	10	10.67	17	44	43	44	43.67
18	11	11	10	10.67	18	44	43	44	43.67
20	11	11	10	10.67	20	44	43	44	43.67
21	11	11	10	10.67	21	44	43	44	43.67
22	11	11	10	10.67	22	44	43	44	43.67
23	11	11	10	10.67	23	44	43	44	43.67
24	11	11	10	10.67	24	44	43	44	43.67

Table A5 Ethylene pressure drop for the adsolubilization and admicellar polymerization steps of the system without surfactant at 8.2 mM surfactant concentration and 6:1 initiator to surfactant ratio.

Adsolubilization process					Admicellar polymerization process				
Time (h)	Pressure drop (psi)				Time (h)	Pressure drop (psi)			
	No.1	No.2	No.3	Ave		No.1	No.2	No.3	Ave
0	0	0	0	0.00	0	0	0	0	0.00
1	4	3	5	4.00	1	9	7	11	9.00
2	6	6	7	6.33	2	18	15	14	15.67
3	8	7	9	8.00	3	23	19	18	20.00
4	9	9	9	9.00	4	28	24	22	24.67
5	10	10	10	10.00	5	33	30	28	30.33
6	10	10	10	10.00	6	38	36	34	36.00
7	10	10	10	10.00	7	40	39	37	38.67
8	10	10	10	10.00	8	42	41	40	40.00
9	10	10	10	10.00	9	42	40	41	41.00
10	10	10	10	10.00	10	42	41	41	41.33
11	10	10	10	10.00	11	43	41	41	41.67
12	10	10	10	10.00	12	43	41	41	41.67
13	10	10	10	10.00	13	43	41	41	41.67
14	10	10	10	10.00	14	43	41	41	41.67
15	10	10	10	10.00	15	43	41	41	41.67
16	10	10	10	10.00	16	43	41	41	41.67
17	10	10	10	10.00	17	43	41	41	41.67
18	10	10	10	10.00	18	43	41	41	41.67
20	10	10	10	10.00	20	43	41	41	41.67
21	10	10	10	10.00	21	43	41	41	41.67
22	10	10	10	10.00	22	43	41	41	41.67
23	10	10	10	10.00	23	43	41	41	41.67
24	10	10	10	10.00	24	43	41	41	41.67

Table A6 Ethylene pressure drop for the adsolubilization and admicellar polymerization steps of the system with surfactant at 15 mM surfactant concentration and 3:1 initiator to surfactant ratio.

Adsolubilization process					Admicellar polymerization process				
Time (h)	Pressure drop (psi)				Time (h)	Pressure drop (psi)			
	No.1	No.2	No.3	Ave		No.1	No.2	No.3	Ave
0	0	0	0	0.00	0	0	0	0	0.00
1	5	4	6	5.00	1	3	9	5	5.67
2	7	6	9	7.33	2	16	16	9	13.67
3	9	7	10	8.67	3	20	22	20	20.67
4	10	10	11	10.33	4	24	25	24	24.33
5	11	11	12	11.33	5	30	29	27	28.67
6	11	11	12	11.33	6	32	30	32	31.33
7	12	11	12	11.67	7	36	32	35	34.33
8	12	11	12	11.67	8	37	33	37	35.67
9	12	11	12	11.67	9	38	35	37	36.67
10	12	11	12	11.67	10	38	37	38	37.67
11	12	11	12	11.67	11	38	38	38	38.00
12	12	11	12	11.67	12	38	38	39	38.33
13	12	11	12	11.67	13	38	38	39	38.33
14	12	11	12	11.67	14	38	38	39	38.33
15	12	11	12	11.67	15	38	38	39	38.33
16	12	11	12	11.67	16	38	38	39	38.33
17	12	11	12	11.67	17	38	38	39	38.33
18	12	11	12	11.67	18	38	38	39	38.33
20	12	11	12	11.67	20	38	38	39	38.33
21	12	11	12	11.67	21	38	38	39	38.33
22	12	11	12	11.67	22	38	38	39	38.33
23	12	11	12	11.67	23	38	38	39	38.33
24	12	11	12	11.67	24	38	38	39	38.33

Table A7 Ethylene pressure drop for the adsolubilization and admicellar polymerization steps of the system without surfactant at 15 mM surfactant concentration and 3:1 initiator to surfactant ratio.

Adsolubilization process					Admicellar polymerization process				
Time (h)	Pressure drop (psi)				Time (h)	Pressure drop (psi)			
	No.1	No.2	No.3	Ave		No.1	No.2	No.3	Ave
0	0	0	0	0.00	0	0	0	0	0.00
1	4	3	6	4.33	1	4	10	7	7.00
2	7	5	8	6.67	2	12	18	16	15.33
3	9	6	9	8.00	3	19	23	21	21.00
4	9	7	10	8.67	4	26	29	27	27.33
5	9	11	10	10.00	5	32	29	29	30.00
6	9	11	10	10.00	6	33	33	32	32.67
7	9	11	10	10.00	7	33	34	35	34.00
8	9	11	10	10.00	8	34	34	35	34.33
9	9	11	10	10.00	9	34	35	36	35.00
10	9	11	10	10.00	10	35	35	36	35.33
11	9	11	10	10.00	11	35	35	36	35.33
12	9	11	10	10.00	12	35	35	36	35.33
13	9	11	10	10.00	13	35	35	36	35.33
14	9	11	10	10.00	14	35	35	36	35.33
15	9	11	10	10.00	15	35	35	36	35.33
16	9	11	10	10.00	16	35	35	36	35.33
17	9	11	10	10.00	17	35	35	36	35.33
18	9	11	10	10.00	18	35	35	36	35.33
20	9	11	10	10.00	20	35	35	36	35.33
21	9	11	10	10.00	21	35	35	36	35.33
22	9	11	10	10.00	22	35	35	36	35.33
23	9	11	10	10.00	23	35	35	36	35.33
24	9	11	10	10.00	24	35	35	36	35.33

Appendix B Weight Loss of Polyethylene on the Glass Fiber Surface

Table B Percentage weight loss of various types of surface modified glass fiber.

Surfactant concentration (mM)	Initiator to surfactant ratio	Condition	Weight loss(g)			Weight loss (%)
			No 1	No 2	Average	
-	-	Untreated glass fiber	0.0008	0.0010	0.0009	0.0300
-	-	As-received glass fiber	0.0020	0.0021	0.00205	0.0672
8.2	3:1	Admicellar and solution treated glass fiber	0.0048	0.0050	0.0049	0.1636
8.2	3:1	Solution treated glass fiber	0.0047	0.0046	0.00465	0.1552
8.2	6:1	Admicellar and solution treated glass fiber	0.0060	0.0060	0.0060	0.2003
8.2	6:1	Solution treated glass fiber	0.0059	0.0059	0.0059	0.1970
15.0	3:1	Micelle, admicellar and solution treated glass fiber	0.0051	0.0052	0.00515	0.1719
15.0	3:1	Solution treated glass fiber	0.0050	0.0052	0.0051	0.1702

Appendix C Mechanical Properties of Glass Fiber Reinforced HDPE Composites

Tensile strength at yield of glass fiber reinforced HDPE composites

Table C1 The tensile strength values of untreated and as-received glass fiber reinforced HDPE composites.

No.	Tensile strength at yield of glass fiber/HDPE composite (Mpa)	
	Untreated glass fiber	As-received glass fiber
1	23.832	24.072
2	23.532	23.877
3	23.377	23.777
4	23.702	23.907
5	23.451	24.086
6	23.470	23.169
7	23.943	23.439
Mean	23.615	23.761
SD	0.21	0.34

Table C2 The tensile strength values of various types of surface modified glass fiber reinforced HDPE composites.

No.	Tensile strength at yield of glass fiber/HDPE composite (MPa)					
	8.2 mM Surfactant concentration				15 mM Surfactant concentration	
	3:1 Initiator:surfactant		6:1 Initiator:surfactant		3:1 Initiator:surfactant	
	Admicellar and solution treated glass fiber	Solution treated glass fiber	Admicellar and solution treated glass fiber	Solution treated glass fiber	Micelle, admicellar and solution treated glass fiber	Solution treated glass fiber
1	27.814	27.333	27.512	27.903	28.169	27.352
2	27.094	26.810	27.318	27.136	26.811	27.076
3	27.025	27.694	27.030	27.400	27.816	27.335
4	26.930	27.242	27.683	27.052	26.689	27.769
5	27.436	27.623	26.713	27.180	27.687	27.961
6	27.657	26.845	27.435	27.536	27.992	27.564
7	26.925	27.522	26.715	27.180	26.689	28.119
Mean	27.269	27.296	27.201	27.341	27.408	27.597
SD	0.36	0.35	0.39	0.30	0.65	0.37

Flexural strength at yield of glass fiber reinforced HDPE composite

Table C3 The flexural strength values of untreated and as-received glass fiber reinforced HDPE composites.

No.	Flexural strength at yield of glass fiber/HDPE composite (Mpa)	
	Untreated glass fiber	As-received glass fiber
1	33.337	33.220
2	32.852	33.359
3	33.191	33.304
4	32.568	33.352
5	33.379	32.694
6	32.575	32.766
7	33.121	32.871
Mean	33.003	33.081
SD	0.34	0.29

Table C4 The flexural strength values of various types of surface modified glass fiber reinforced HDPE composites.

No.	Flexural strength at yield of glass fiber/HDPE composite (Mpa)					
	8.2 mM Surfactant concentration				15 mM Surfactant concentration	
	3:1 Initiator:surfactant		6:1 Initiator:surfactant		3:1 Initiator:surfactant	
	Admicellar and solution treated glass fiber	Solution treated glass fiber	Admicellar and solution treated glass fiber	Solution treated glass fiber	Micelle, admicellar and solution treated glass fiber	Solution treated glass fiber
1	35.529	35.739	36.487	35.522	34.843	35.811
2	35.306	35.651	35.941	34.878	34.752	35.790
3	34.196	35.853	35.511	34.424	35.068	35.451
4	35.029	35.548	34.999	35.347	36.073	35.266
5	35.376	35.122	36.220	35.047	36.345	34.992
6	34.486	36.675	35.228	34.732	36.299	34.890
7	35.139	35.560	34.875	34.607	36.149	34.277
Mean	35.001	35.593	35.607	35.080	35.647	35.211
SD	0.61	0.23	0.62	0.43	0.72	0.54

Impact strength of glass fiber reinforced HDPE composite

Table C5 The impact strength values of untreated and as-received glass fiber reinforced HDPE composites.

No.	Impact strength of glass fiber/HDPE composite (KJ/m ²)	
	Untreated glass fiber	As-received glass fiber
1	9.0	9.5
2	9.0	9.8
3	7.9	9.7
4	8.2	9.3
5	8.0	9.0
6	9.0	9.3
7	8.8	9.7
Mean	8.55	9.47
SD	0.50	0.29

Table C6 The impact strength values of various types of surface modified glass fiber reinforced HDPE composites.

No.	Impact strength of glass fiber/HDPE composite (KJ/m ²)					
	8.2 mM Surfactant concentration				15 mM Surfactant concentration	
	3:1 Initiator:surfactant		6:1 Initiator:surfactant		3:1 Initiator:surfactant	
	Admicellar and solution treated glass fiber	Solution treated glass fiber	Admicellar and solution treated glass fiber	Solution treated glass fiber	Micelle, admicellar and solution treated glass fiber	Solution treated glass fiber
1	8.0	7.6	8.1	8.2	8.3	8.3
2	7.9	8.2	7.4	6.8	7.3	7.7
3	8.1	7.9	7.1	8.4	8.8	7.2
4	7.6	8.3	7.4	7.0	8.5	7.2
5	7.4	8.7	6.8	8.3	7.0	7.0
6	7.2	7.1	8.4	8.1	7.0	7.0
7	7.8	7.2	7.7	7.2	7.6	7.5
Mean	7.71	7.86	7.56	7.71	7.78	7.41
SD	0.33	0.59	0.56	0.68	0.74	0.47

CURRICULUM VITAE

Name: Ms. Bongkot Sithitham

Date of Birth: November 16, 1979

Nationality: Thai

University Education:

1997-2000 Bachelor Degree of Science in Chemistry, Kasetsart University, Bangkok, Thailand.

