

REFERENCES

- Bitting, Daryl. (1985) Specific counterion effects in anionic surfactant adsorption on a mineral oxide surface. MS. Thesis, The Oklahoma University, Norman, USA.
- Bowornprasirtkul, Auchara. (2002) Characterization of polypyrrole coated latex particles by admicellar polymerization. M.S. Thesis, The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok, Thailand.
- Brydson, JA. (1978) Rubber chemistry (112-155) England : Applied science publishers Ltd.
- Bunsomsit, K., Magaraphan, R., O'Rear, E.A., and Grady, B.P. (2002) Polypyrrole-coated natural rubber latex by admicellar polymerization. Colloid Polymer Science, 280, 509–516.
- Chantarak, S. (2006). Synthesis and Characterization of Polypyrrole Coated latex Particles by admicellar polymerization. M.S. Thesis, The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok, Thailand.
- C.J.B.Clews and F.Schoszberger. (1937) Structure of stretch rubber, Proceedings of the Royal Society of London. Series A. Mathematical and Physical Sciences 7, 491-496
- C.T. Nguyen, T. Vu-Khanh, and J. Lara. (2004) Puncture characterization of rubber membranes. Theoretical and Applied fracture mechanics, 42, 25-33.
- David K, Nichols, Pittsfield, and Mass. (1993) U.S. Patent, 5260110.
- Denis H., James William, and M. Castor. (2005) “Styrene” in Ullmann’s Encyclopedia of Industrial Chemistry, Wiley-VCH, Weinheim.
- Kosuke Nishio, Yuka Masaike, Morihito Ikeda, Hiroki Narimatsu, and Nobuyuki Gokon. (2008) Development of novel magnetic nano-carriers for high-performance affinity purification. Colloids and surfaces b: biointerfaces, 8, 475-483.
- Michael Dixon MSE 632, and Professor Carey. (2004) A review of biodegradable polymer technology and recommendation for introduction of pilot scale

- collection and composting infrastructure in Lexington Kentucky. Polylactic acid(PLA), 15, 173-180.
- Naoko Okamoto, Tomokazu Yoshimura, and Kunio Esumi. (2004) Effect of pH on adsolubilization of single and binary organic solutes into a cationic hydrocarbon surfactant adsorbed layer on silica. Journal of colloid and interface science, 275, 612-617.
- Pakpoom Rungruang, Brian P. Grady, and Pitt Dupaphol. (2006) Surface-modified calcium carbonate particles by admicellar polymerization to be used as filler for isotactic polypropylene. Colloids and surfaces a Physicochem eng aspects, 275, 114-125.
- Paranee Nontasorn, Sumaeth Chavadej, Pramoch Rangsunvigit, John H. and O'Haver. (2005) Admicellar polymerization modified silica via a continuous stirred-tank reactor system: comparative properties of rubber compounding. Chemical engineering journal, 108, 213-218.
- Pongprayoon, T., Yanumet, N., and O'Rear, E.A. (2002) Admicellar Polymerization of Styrene on Cotton. Journal of Colloid and Interface Science, 249, 227-234.
- Qing Zhao, Justin Simmons, and Eric D.Conte. (2006) Investigation of a variety of cationic surfactants attached to cation-exchange silica for hydrophobicity optimization in admicellar solid-phase extraction for high-performance liquid and gas chromatography. Journal of chromatography a, 1132, 1-7.
- Ralph H. Bland, James M. Jonza, James D. Smith, and Richard C. Allen. (1998) U.S. Patent, 5604019.
- Rhutesh K. Shah, Rajendra K. Krishnaswamy, Shuichi Takahashi, and D.R. Paul. (2006) Blown films of nanocomposites prepared from low density polyethylene and a sodium ionomer of poly(ethylene-co-methacrylic acid) Polymer, 47, 6187-6201.
- Rosen, M.J. (1989) Surfactants and Interfacial Phenomena. (pp1-123) New Jersey: John Wiley & Sons, Inc.
- Srinarang, Vijitra (2004) Admicellar polymerization of polystyrene on natural rubber particles. M.S. Thesis, The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok, Thailand.

- Thirawudh Pongprayoon, Nantaya Yanumet, Edgar A. O'Rear, Walter E. Alvarez, and Daniel E. Resasco. (2005) Surface characterization of cotton coated by a thin film of polystyrene with and without a cross-linking agent. Journal of colloid and interface science, 281, 307-315.
- Walter B. Mueller, Inman, S.C. (1998) U.S. Patent, 5789046.
- Wongpun, T, The effect of dopants on the resistivity of conductive polymer-coated fabric. M.S. Thesis, The Petroleum and Petrochemical College, Chulalongkorn (2004).
- Xuman Wang, Caining Zhang, Xiaoliang Wang, and Hongchen Gu. (2007) The study on magnetite particles coated with bilayer surfactants. Applied Surface science, 253, 7516-7521.

APPENDICES

Appendix A Calculation of Percent Weight Polystyrene and Poly(Methyl Methacrylate) in Admicellar Modified Natural Rubber

$$\text{Weight of PS} = \frac{\text{conc.of styrene monomer (mM)} \times 104.5 \times \text{total volume}}{1000 \text{ ml} \times 1000}$$

Ex. Conc. Of styrene monomer = 20 mM and total volume = 100 ml.

$$\begin{aligned} \text{Weight of PS} &= \frac{20 \text{ mM} \times 104.5 \text{ g/mole} \times 100 \text{ ml}}{1000 \text{ ml} \times 1000} \\ &= 0.209 \text{ g} \end{aligned}$$

Total weight of admicelled PS-NR = 5 + 0.209 = 5.209 g

$$\begin{aligned} \% \text{ Wt. of PS} &= \frac{(0.209 \times 100)}{5.209} = 4.01 \% \end{aligned}$$

$$\text{Weight of PMMA} = \frac{\text{conc.of MMA monomer (mM)} \times 104.5 \times \text{total volume}}{1000 \text{ ml} \times 1000}$$

Ex. Conc. Of MMA monomer = 20 mM and total volume = 100 ml.

$$\begin{aligned} \text{Weight of PMMA} &= \frac{20 \text{ mM} \times 100.12 \text{ g/mole} \times 100 \text{ ml}}{1000 \text{ ml} \times 1000} \\ &= 0.200 \text{ g} \end{aligned}$$

Total weight of admicelled PMMA-NR = 5 + 0.200 = 5.200 g

$$\begin{aligned} \% \text{ Wt. of PMMA} &= \frac{(0.200 \times 100)}{5.200} = 3.85 \% \end{aligned}$$

Table A1 wt % of PS in admicelled PS-NR with different concentrations of styrene monomer

Samples	NR used (g)	Calculated PS (g)	Admicelled PS-NR (g)	% Wt. of PS (%)
20 mM-styrene	5	0.209	5.209	4.01
50 mM-styrene	5	0.523	5.523	9.46
100 mM-styrene	5	1.045	6.045	17.29
200 mM-styrene	5	2.090	7.090	29.48
300 mM-styrene	5	3.135	8.135	38.54

Table A2 wt % of PMMA in admicelled PMMA-NR with different concentrations of methyl methacrylate monomer

Samples	NR used (g)	Calculated PMMA (g)	Admicelled PMMA-NR (g)	% Wt. of PMMA (%)
20 mM- methyl methacrylate	5	0.200	5.200	3.85
50 mM- methyl methacrylate	5	0.500	5.500	9.10
100 mM- methyl methacrylate	5	1.001	6.001	16.68
200 mM- methyl methacrylate	5	2.002	7.002	28.59
300 mM- methyl methacrylate	5	3.004	8.003	37.52

Appendix B Data of Rheology

Table B1 Apparent shear viscosity data of NR blended with PS-NR, PS-Mag and PS

Shear rate (1/s)	Apparent shear viscosity (Pa*s)	
	NR blend PS	NR blend PS and PS-Mag
10	12661.25	12590
20	8205	7851.25
40	5004.375	4880.625
80	2979.687	3068.125
160	1931.953	1940.781
320	1301.953	1308.594
640	795.762	815.664
1200	494.552	459.781
2400	273.51	263.781
4800	161.07	144.859

Table B2 Die swell data of NR blended with PS-NR, PS-Mag and PS

Shear rate (1/s)	Die swell (l/l_0)	
	NR blend PS	NR blend PS and PS-Mag
10	1.1766	1.4341
20	1.5946	1.6209
40	1.552	1.5734
80	1.6065	1.0988
160	2.0694	1.3746
320	1.6332	1.7321
640	1.6201	1.8735
1200	1.632	1.5747
2400	1.5524	1.5886
4800	161.07	144.859

Table B3 Apparent shear stress data of admicelled PS-NR and admicelled PS-NR blend with 0.5 % admicelled PS-Mag

Shear rate (1/s)	Apparent shear stress (Pa)	
	PS-NR-Mag	PS-NR
10	19800	24750
20	19087.5	36775
40	19800	41725
80	19800	55162.5
160	22625	128025
320	52337.49	116712.5
640	80637.5	178250
1200	118825	213612.5
2400	157737.5	237662.5
4800	200887.5	282225

Table B4 Apparent shear viscosity data of admicelled PS-NR and admicelled PS-NR blend with 0.5 % admicelled PS-Mag

Shear rate (1/s)	Apparent shear viscosity (Pa*s)	
	PS-NR-Mag	PS-NR
10	1980	2475
20	954.375	1838.75
40	495	1043.125
80	247.5	689.531
160	141.406	800.156
320	163.555	364.727
640	125.996	278.516
1200	99.021	178.01
2400	65.724	99.026
4800	41.852	58.797

Table B5 Die swell data of admicelled PS-NR and admicelled PS-NR blend with 0.5 % admicelled PS-Mag

Shear rate (1/s)	Die swell (l/l_0)	
	PS-NR-Mag	PS-NR
10	1.1766	3.29567
20	1.5946	3.339
40	1.552	1.195
80	1.6065	2.18503
160	2.0694	2.15
320	1.6332	2.13
640	1.6201	2.13
1200	1.632	2.1
2400	1.5524	2.09411

Table B6 Apparent shear stress data of admicelled PMMA-NR and admicelled PMMA-NR blend with 0.5 % admicelled PMMA-Mag

Shear rate (1/s)	Apparent shear stress(Pa*s)	
	PMMA-NR-Mag	PMMA-NR
10	24050	87000
20	35362.5	132975
40	46675	140762.5
80	75675	186025
160	89125	205837.5
320	123075	276575
640	158437.5	274450
1200	197350	340237.5
2400	223512.5	391875
4800	260300	414500

Table B7 Apparent shear viscosity data of admicelled PMMA-NR and admicelled PMMA-NR blend with 0.5 % admicelled PMMA-Mag

Shear rate (1/s)	Apparent shear viscosity (Pa*s)	
	PMMA-NR-Mag	PMMA-NR
10	2405	8700
20	1768.125	6648.749
40	1166.875	3519.062
80	945.937	2325.312
160	557.031	1286.484
320	384.609	864.297
640	247.559	428.828
1200	164.458	283.531
2400	93.13	163.281
4800	54.229	86.354

Table B8 Die swell data of admicelled PS-NR and admicelled PS-NR blend with 0.5 % admicelled PS-Mag

Shear rate (1/s)	Die swell (l/l ₀)	
	PMMA-NR-Mag	PMMA-NR
10	1.788968	3.555867
20	1.769903	3.169567
40	1.767484	2.272467
80	2.070839	2.118267
160	1.966419	2.413467
320	1.826226	2.2523
640	1.726548	2.236767
1200	1.781194	2.339733
2400	1.749	2.1897

Appendix C Data of Gel Permeation Chromatography

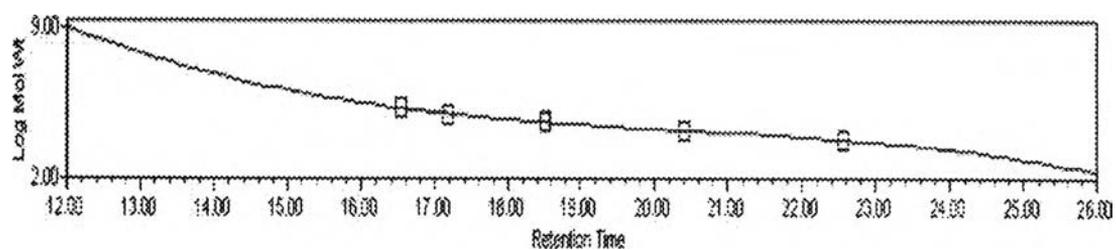


Figure C1 Calibration curve of styrene standard solution by Gel Permeation Chromatography.

Table C1 Data of calibration curve

	Retention time (min)	Molecular weight	Log molecular weight
1	16.542	188000	5.2742
2	17.247	103000	5.0128
3	18.547	43700	4.6405
4	20.417	17800	4.2504
5	22.645	6520	3.8142

CIRRICULUM VITAE

Name: Ms. Nuttida Srirachya

Date of Birth: April 17, 1985

Nationality: Thai

University Education:

2003-2007 Bachelor Degree of Material Science, Faculty of Science, Department of Material Science, Chulalongkorn University, Bangkok, Thailand.

Proceeding:

1. Srirachya, N.; Magaraphan, R.; and Chaisuwan, T. (2008, August 19-20) Surfactant Aid in Admicellar Polymerization of Styrene on Natural Rubber Latex. Proceeding of the Thai-Japan Joint Symposium on Advances in Materials Science and Environmental Technology 2008, Bangkok, Thailand.
2. Srirachya, N.; Chaisuwan, T.; and Magaraphan, R. (2008, November 6-8) Extrusion of Admicelled Natural Rubber Filled with Nanomagnetic Particles. Proceeding of the NanoThailand Symposium 2008, Bangkok, Thailand.
3. Srirachya, N.; Chaisuwan, T.; and Magaraphan, R. (2009, February 25-27) Admicellar Polymerization of Styrene and Methyl Methacrylate on Natural Rubber Latex. Proceeding of the GPEC Conference 2009, Orlando, Florida, USA.
4. Srirachya, N.; Magaraphan, R.; and Chaisuwan, T. (2009, April 22) Admicelled Natural Rubber Filled with Nanomagnetic Particles: Synthesis and Optimization Studies. Proceeding of the 15th PPC Symposium on Petroleum, Petrochems, and Polymers, Bangkok, Thailand.

Presentations:

1. Srirachya, N.; Magaraphan, R.; and Chaisuwan, T. (2008, August 19-20) Surfactant Aid in Admicellar Polymerization of Styrene on Natural Rubber Latex. Proceeding of the Thai-Japan Joint Symposium on Advances in Materials Science and Environmental Technology 2008, Bangkok, Thailand.
2. Srirachya, N.; Chaisuwan, T.; and Magaraphan, R. (2008, November 6-8) Extrusion of Admicelled Natural Rubber Filled with Nanomagnetic particles. Proceeding of the NanoThailand Symposium 2008, Bangkok, Thailand.



3. Srirachya, N.; Chaisuwan, T.; and Magaraphan, R. (2009, February 25-27) Admicellar Polymerization of Styrene and Methyl Methacrylate on Natural Rubber Latex . Proceeding of the GPEC Conference 2009, Orlando, Florida, USA.
4. Srirachya, N.; Magaraphan, R.; and Chaisuwan, T. (2009, April 22) Admicelled Natural Rubber Filled with Nanomagnetic Particles: Synthesis and Optimization Studies. Proceeding of the 15th PPC Symposium on Petroleum, Petrochems, and Polymers, Bangkok, Thailand.