

P



THE POLYMER PROCESSING SOCIETY (PPS)  
ASIA/AUSTRALIA REGIONAL MEETING 1999

# PROCEEDINGS

## INNOVATION IN POLYMER PROCESSING

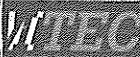
In memory of Professor Morand Lamba  
President of PPS 1995-97

Marriott Royal Garden Riverside Hotel  
Bangkok, Thailand

December 1-3, 1999



Co-sponsored by



National Metal and Materials Technology Center (MTEC)  
National Science and Technology Development Agency (NSTDA)  
Ministry of Science, Technology and Environment (MoSTBE)



The Federation of Thai Industries  
(Plastic Industry Club)



Thai Plastic Industries  
Association

**TABLE OF CONTENTS**

Technical Program .....	XIII
Committees .....	XV
<b>PLENARY LECTURES</b>	
PL-1 Creating Block Copolymers via Melt Coupling Reactions .....	1
C.A. Orr, F.S. Bates and C.W. Macosko	
PL-2 Twin Screw Extrusion: Technology, Science, Analysis and Design .....	3
J.L. White	
<b>KEYNOTE LECTURES</b>	
KL-1 Compounding and Mixing of Polymer Blends .....	5
L.A. Utracki	
KL-2 Recent Technological Developments and the Computer Simulation of the Film Blowing Process .....	9
J. Vlachopoulos and V. Sidiropoulos	
KL-3 Rheological Characterization of Structure Developments in Polymer Melts .....	14
T. Masuda and H. Kashihara	
KL-4 Virtual Instruments in Plastic/Polymer Education: Blown Film Extrusion .....	17
I.R. Harrison, J.C. Chen, K. Cantor and D. Simpson	
KL-5 Novel Thermoplastic Elastomers from Blends of Rubbers and Plastics .....	20
A.K. Bhowmick and A. Jha	
KL-6 Multiphase Toughened Epoxy as Composite Matrix: Design and Selection of Tougheners .....	25
C.R. Choe and J.K. Kim	
KL-7 Polymer Alloys with Morphology Spectrum .....	27
S.C. Kim, Y.S. Kim and H.S. Min	
KL-8 Strategies for Effective Melt Reprocessing- Case Studies including Polypropylene Postconsumer Waste, Tyre Crumb Composites, Stretch Film and Expanded Polystyrene .....	30
G.R. Churchward	
KL-9 Technology Breakthroughs in the Production of Injection Moulded Components .....	35
G.F. Smith	
KL-10 Computer Aided Rotational Moulding and Thermoforming of Medical Devices .....	39
S.H. Teoh, M. Umezu, C.Y. Lau and M. Ranawake	
KL-11 Influence of Design on Mixing Efficiency in Polymer Processing Equipment .....	41
I. Manas-Zloczower	
KL-12 A Review on the Theoretical Tools for Extrusion Die Design .....	43
T.-J. Liu	

# ORAL PRESENTATIONS

## Room A

### SYMPOSIUM I : Reactive Processing

A-1	Reactive Extrusion and Polypropylene Rheological Behavior Changes .....	45
	D. Graebling	
A-2	Morphology Control on Particle Size-asphericity Map in Reactive Blending .....	48
	P. Charoensirisomboon, T. Inoue, S.I. Solomko, G.M. Sigalov and M. Weber	
A-3	Reactive Blending of Polyethylene and Poly(vinyl chloride) using Methyl Methacrylate as Compatibilizer .....	51
	R. Magaraphan, C. Towichayathamrong and A.M. Jamieson	
A-4	Studies on The Mechanical Properties and Morphology of Reactively Compatibilised PA6/EVA Blends .....	55
	A.R. Bhattacharyya and A. Misra	
A-5	Grafting Copolymerization of Acrylic Acid onto PE Film through Corona Discharge .....	58
	J. Lei and X. Liao	
A-6	Interfaces in Polyolefin/Polyethylene Terephthalate Blends Reactively Compatibilized by Glycidyl Methacrylate Copolymers .....	60
	M.F. Champagne	
A-7	Reative Immiscible Polymer Blends: Investigation of the Interfacial Reactions, Phase Morphology Generation and Stabilization .....	63
	G. Groeninckx and K. Dedecker	
A-8	Influence of Compatibilizers on Dispersity and Properties of Dynamically Vulcanized Polyolefine-Rubber Blends .....	64
	H.-J. Radusch	
A-9	Enhancement of Compatibility of Polyolefine Based Materials through Radiation Processing .....	67
	X. Xu	

### SYMPOSIUM II : Polymer Blends and Alloys

A-10	Transcrystallinity at the Interface of iPP/Cellulose Allomorphs .....	69
	S.-S. Im, Y.M. Lee and C.H. Cho	
A-11	Plastification/Melting and Morphology Development in Polymer Blends in a Twin Screw Extruder ZSK40 .....	71
	H. Potente, M. Stephan, P. Potschke and M. Bastian	
A-12	Melt Flow Induced Phase Morphologies in Polyolefin Blends .....	74
	R. A. Venables, A. Tabtiang, B. Parchana and P. Supatham	
A-13	Influence of Molecular Weight and Composition on Compatibility and Properties of LLDPE/NR Blends .....	76
	R. Magaraphan, P.Limsila and A.M. Jamieson	
A-14	In-situ Reinforcing and Toughening of a Semiflexible Thermotropic Copolyesteramide in PBT/PA66 Blends .....	79
	X.L. Xie, S.C. Tjong and R.K.Y. Li	

A-15	Effect of Reaction Rate on Morphological Change of Reactive Blends .....	81
	H.K. Jeon and J.K. Kim	
A-16	Studies on Mechanical Properties and Morphology of PP/PBT Blends with Reactive Compatibilisation .....	84
	P. Jain, A.K.Ghosh and A. Misra	
A-17	Preparation of Polymer Blends by Controlled Phase Separation .....	87
	S. Thanawan, D. Graebling and C. Picot	
A-18	Deformation Behavior of Blends of HMW-PEN/LMW-PEN .....	90
	M. Ito	
A-19	Impact Toughening of Polypropylene Binary Blends : Role of Disperse Phase Morphology .....	92
	S.H. Jafari and A.K. Gupta	
A-20	Mechanical Properties of High Density Polyethylene and Polypropylene Blends with Ethylene-Propylene-Diene-Terpolymer .....	95
	S. Puajindanetr and A. Udomsakdigool	
A-21	The Influence of Composition upon the Barrier Properties of the Polyethylene/Compatibilizer Precursor/Modified Polyamide Blends .....	98
	W.-S. Jou, K.-N. Chen, S.-S. Chang, H.-T. Yao and J.-T. Yeh	
A-22	Structural, Rheological, and Mechanical Properties of Ternary Blends of LCP/Polyester/Polyamide	101
	M. Kyotani and A. Saeed	

## Room B

### **SYMPORIUM III : Extrusion and Extrusion-Based Process**

B-1	The Combination of the Study of Polymer Extrusion Theory with Polymer Morphology : The On-line Macro- and Micro-scopically Visual Study .....	103
	F. Zhu, Y. Guo, M. Yuan, Y. Liu, Y. Xing and B. Yan	
B-2	Structure-Processing-Property Relationships of LDPE .....	105
	N. Thavarungkul, B.K. Rearick and I.R. Harrison	
B-3	The Influence of Using Fluoropolymer Based Processing Additives to Improve the Extrusion of High Viscosity LLDPE Resins Through Narrow Die Configurations .....	106
	E.W. Adair and J. Horns	
B-4	Tribological Investigation of Oriented HDPE .....	109
	M. Hoseini, J. Lausma and A. Boldizar	
B-5	On-line NIR Sensing of CO <sub>2</sub> Concentration in Polypropylene Foaming Process .....	112
	M. Ohshima, T. Nagata and M. Tanigaki	
B-6	In situ Synchrotron X-Ray Studies of Structure Development during Model Fiber Processing .....	115
	J.M. Samon, J. Wu, J.M. Schultz and B.S. Hsiao	

B-7 Control of Polymer Morphology During the Small-scale Melt Spinning of Monofilament Fibres .....	118
R. Molloy, J. Siripitayananon, N. Molloy, M. Sriyai, M. Srisa-ard, A. Charuchinda, P. Muhamed, K. Na Lampang	
B-8 Electrical Process for Making Polymer Nanofibers .....	121
D.H. Reneker, H. Fong, S. Koombhongse and A. Yarin	
B-9 Numerical Simulation of Double-Layer Flow from Tube-in-Orifice Spinnerets .....	124
H. Watanabe, S. Kihara and K. Funatsu	
B-10 Extruded Continuous Filament Nonwovens .....	127
G.S. Bhat	

#### **SYMPORIUM IV : *Rubber Processing***

B-11 A Very Low Shear Techniques to Study Flow Induced Anisotropy Effects : Application to Filled Elastomers .....	129
J.L. Leblanc, S. Guillet and C. Barres	
B-12 New Miscible Elastomer Blends form Acrylate Rubber and Fluororubber .....	132
M. Abdul Kader and A.K. Bhowmick	
B-13 Effect of Compound Formulations and Processing Conditions on the Properties of Extruded EPDM and NR/EPDM Blend Foams .....	135
C.K. Lewis, Y. Rodlum and S. Changchum	

#### **SYMPORIUM V : *Injection Molding***

B-14 Visualization Analysis of Silver-Streak Generation Phenomena in Downstream Area of Rib-Cavity .....	138
H. Yokoi and T. Otake	
B-15 Visualization Analysis of Plastication Process under Starve-Feeding Conditions .....	141
H. Yokoi, S. Takatsugi and T. Kawasaki	
B-16 Visualization Analysis of Flow Mark Generation Phenomena Observed in PP/Rubber/Talc .....	143
H. Yokoi and J. Narita	
B-17 Visual Analysis of Cavity Filling and Packing Process in Injection Molding of Phenolic Resin by Gate-Magnetization Method .....	146
T. Ohta and H. Yokoi	
B-18 Experimental Analysis of Pressure Measurement Errors in a Mold Cavity .....	148
H. Yokoi and H. Ono	
B-19 Measurement of Melt Temperature Profiles along Cavity Thickness by Using a New Integrated Thermocouple Sensor (Part II : Influence of Cavity Conditions on Temperature Profiles) .....	151
Y. Murata, S. Abe and H. Yokoi	
B-20 Paint Free Molding for Housing of Electronic Equipment .....	154
M. Iida, T. Kohno, K. Nakamura and S. Matsuoka	
B-21 Rapid Prototype Tooling-Aluminium Filled Epoxy and Polyester Composites .....	156
G. Churchward and C.P. Prakash Babu	

B-22 A Study into The Use of A Static Injection Blender on Injection Molding Machines to Improve The Mixing Efficiency of The System .....	157
Rudolf Maurer	

 Room C

<b>SYMPORIUM VI : Computational Modeling and Simulations in Polymer Processing</b>	
C-1 Modelling of Structure Development during Flow using a Diffuse-interface Method .....	160
M. Verschueren, F.N. van de Vosse and H.E.H. Meijer	
C-2 Brownian Dynamics Simulation of Non-dilute Fibre Suspension Flows in a Center-Gated Disk .....	163
R. Zheng, P. Kennedy, X-J. Fan, N. Phan-Thien and R.I. Tanner	
C-3 Experimental Evaluation of a Novel Asymptotic Model for Predicting the Melt Flow Front Development of Pseudoplastic Polymers in Injection Molding Process .....	166
F. Pisciotti, A. Boldizar and G. Aronsson	
C-4 Optimization of Filling Process in RTM using Genetic Algorithm and Experimental Design Method .....	169
B.Y. Kim, H.S. Ryu, G.J. Nam and J.W. Lee	
C-5 Simulation of an Amorphous Polyethylene Nanofiber on a High Coordination Lattice .....	172
V. Vao-Soongnern and W.L. Mattice	
C-6 Vulcanised Rubber Characterisation for FEA .....	175
V. Noparatanakailas	
C-7 3D Simulation for Rubber Injection Moulding - A New Tool for Process Optimisation .....	178
L.H. Kallien and C.W.D. Kleeburg	

**SYMPORIUM VII : Polymer Recycling**

C-8 Review and Future for Reuse of Polymers .....	190
B. Haggstrom	
C-9 The Influence of Mixing Parameters on The Properties of Polypropylene and Soft Filler Compounds .....	193
F.H. Axtell, P. Phinyocheep and N. Chantasatratsamy	
C-10 Mechanical Properties of Surface Modified Rubber Powder/Nylon Composite .....	196
S.H. Ryu and J.I. Kim	
C-11 Recycling and Upgrading of Polystyrene from Electronic Scrap Using Siloxanes .....	198
R. Walgers, J.M.N.v. Kasteren and P.J. Lemstra	
C-12 High Stiffness Polyethylene Spiral Drainage Pipe using Recycled Plastics .....	201
H. Kye, N. Sung and S. Choi	
C-13 Closed Loop Recycling of Post-Used HDPE Bottle Crates in Southern Europe .....	204
C.D. Papaspyrides, C.N. Kartalis, R. Pfaendner, K. Hoffmann and H. Herbst	

## **SYMPORIUM VIII : Rheology**

C-14 Viscosity of Polymer-Compressed Gas Mixtures during Extrusion Foaming and Lattice-Hole Theory .....	207
L.A. Utracki and R. Simha	
C-15 Characterization of Commercial Polyethylene Melts Using Transient Extensional Viscosity and Steady Shear Flow Curves .....	210
A. Somwangthanaroj, H. Dreze, D.W. Mead and F.E. Filisko	
C-16 Temperature Dependent Flow Instabilities of a Metallocene LLDPE Melt .....	213
J. Perez-Gonzalez, B. Hausnerova, V. Pavlinek, P. Saha and L. de Vargas	
C-17 Measurement of Elongational Viscosity of Polymer Melt under Processing Conditions .....	216
H. Braun and W. Gleissle	
C-18 In-Line Capillary Rheometer for Extrusion Processes .....	219
C. Nakason, M. Saedan and S. Changchum	
C-19 Processing Behavior of Highly Filled Ethylene Propylene Diene Rubber Compound .....	222
M.G. Markovic, N.R. Choudhury, M. Dimopoulos, J.G. Matisons, N.K. Dutta and A.K. Bhattacharya	
C-20 Positive and Negative Electrorheological Effect of Poly(methyl methacrylate) Dispersions Stabilized by Block Copolymer .....	225
V. Pavlinek, P. Saha, O. Quadrat and J. Stejskal	
C-21 Effect of Water Level on the Rheological Properties of Polyvinyl Alcohol Solution in Dimethyl Sulfoxide .....	228
B.C. Kim and S.G. Kim	
C-22 Controlling Rheological Behaviour of Multigrade Lubricating Oils .....	230
E. Torres, N.K. Dutta, N.R. Choudhury and J.G. Matisons	

## **SYMPORIUM IX : Composites**

D-1 In-situ monitoring of Filling and Curing Behaviors in Liquid Composite Molding .....	233
H.S. Ryu, K.H. Shin, J.G. Kim and J.W. Lee	
D-2 Synthesis and Characterisation of an Isocyanurate-Oxazolidone Polymer .....	236
K.S. Chian, S. Lu, S. Yi and C.Y. Yue	
D-3 Phase Microstructure and Mechanical Properties of Polypropylene Composites Containing Elastomer and Filler Inclusions .....	239
K. Premphet and P. Horanont	
D-4 Fabrication of PVDF/PVDF (Polyvinyl Dimethylsiloxane/Polyvinylidene Fluoride) Composite Hollow Fiber Membranes for VOCs Recovery .....	241
M.L. Yeow, J.F. Kong, D.L. Wang, K. Li and W.K. Teo	
D-5 A Study on HDPE Based Materials with Enhanced Thermal Conductivity .....	243
Q. Wang, J. Guo, R. Wang and Z. Hua	
D-6 The Use of Sol-Gel Technology to Obtain Active Polymer Surfaces for Multicomponent Systems .....	245
V. Rossbach, C. Rehwinkel, A. Sittattrakul and C. Thongpin	

- D-7 Structure Control and Design of Smectite/Polymer Nanocomposites ..... 247  
M. Okamoto, S. Morita and T. Kotaka

- D-8 Development of Polypropylene-Clay Nanocomposite Through the Ultrasonic Melt Intercalation ..... 250  
Y.J. Yoo, C.H. Sohn, H.S. Kim and J.W. Lee

- D-9 Fiber Structure Development in High-Speed Melt Spinning of Nylon 6/Clay Nanocomposite ..... 253  
T. Kikutani, E. Giza, H. Ito and N. Okui

*Symposium X : Blow Molding, Rotomolding and Thermoforming*

- D-10 Computer Simulation of the Rotational Moulding of Plastics ..... 255  
E.J. Wright and R.J. Crawford

- D-11 The Effect of Processing Parameters on the Warpage of Rotationally Molded Parts ..... 258  
S.-J. Liu and C.-Y. Ho

- D-12 Rotational Molding of Polyethylene Foams ..... 260  
S.-J. Liu and C.-H. Tsai

- D-13 Influence of Induced Crystallization on Strain Hardening When Stretching  
Poly(Ethylene Terephthalate) ..... 262  
C. G'Sell, C. Cabot, J.M. Hiver, M. Vigny and A. Aubert

*Symposium XI : Mixing and Compounding*

- D-14 Dispersion in High Viscosity Ratio Polyolefin Blends ..... 265  
M.A. Huneault, F. Mighri, G.H. Ko and K.Nakayama

- D-15 Deformation of Newtonian Droplets in a (super-critical) Time-dependent Elongational Flow ..... 268  
Y.W. Stegeman, A.K. Chesters, F.N. vd Vosse and H.E.H. Meijer

- D-16 Coupling of Micro- and Macro-scale Laminar Mixing : The Extended Mapping Method ..... 271  
P.D. Anderson, O.S. Galaktionov, G.W.M. Peters, H.E.H. Meijer and C.L. Tucker III

- D-17 Investigation of Optimal Compounding Conditions Using Fractal Dimension as  
Quantitative Index ..... 274  
W. Tanthanapanichakoon, T. Charinpanitkul, S. Covavisaruch, A. Thongchiew and M. Suphawita

- D-18 Using the Mapping Method to Optimize Mixing Devices ..... 278  
P.G.M. Kruijt, P.D. Anderson, G.W.M. Peters and H.E.M. Meijer

- D-19 Studies in Impact/Stiffness Balance of Compounds Based on High Flow Polypropylene ..... 281  
Y.B. Vasudeo, R. Rangaprasad and R.R. Sequeira

- D-20 Comparative Study of Mixing Silica, Carbon Black and Other Particles into Elastomers ..... 283  
K.-J. Kim and J.L. White

- D-21 Effect of Type of Clarifying Additive on Organoleptic, Optical and Mechanical Properties of  
PP Homopolymer & Random Copolymer for Baby Feeding Bottles ..... 286  
K.S. Jadhav, N. Shah and S. Awasti

# Poster Presentations

## Charoenakorn Room

### SYNPOSIMUM I : Reactive Processing

- P-1 Microwave-induced Synthesis of Partially Aromatic Polyamides via the Yamazaki Phosphorylation Reaction ..... 288  
A. Pourjavadi
- P-2 The Effect of UV Radiation on the Physical Properties of Oil Extended SBS ..... 289  
H. Geoffrey and T.P. Hung

### SYNPOSIMUM II : Polymer Blends and Alloys

- P-3 Thermal, Mechanical and Diffusional Properties of Nylon 6/ABS Blends :  
Effect of Reactive Compatibilizer ..... 290  
S.P. Jang, J.-H. Kim and D.J. Kim
- P-4 Utilization of Renewable Resources as Fillers for Polymer Blends :  
Mechanical Properties and Microstructure of HDPE Blends ..... 293  
M. Chaovirakij, N. Kaabbuathong, R. Rujiravanit, J.W. Ellis and D.C. Martin
- P-5 Thermoreversible Gelation of Poly(ethylene oxide) Biodegradable Polyester Block Copolymers ..... 296  
D.S. Lee, S.W. Choi and S.Y. Choi
- P-6 Synthesis of The Conducting Soluble Polypyrrole Composites ..... 298  
D.S. Lee, Y.H. Lee and J.Y. Lee
- P-7 Improvement of Volume Resistivity in Polymer Blend of Polyvinylchloride/ Nitrile Rubber ..... 301  
W. Chaiburanont and S. Damrongsakkul
- P-8 Thermoplastic Polymer Blends with High Electrical Conductivity ..... 304  
J.Y. Lee, K.T. Song, D.K. Moon, H.S. Nam, S.Y. Kim, H.Y. Won and C.Y. Kim
- P-9 Pattern Formation of *B*-Continuous SAN/PMMA Blend under Elongational Flow ..... 307  
T. Kotaka, Y.H. Kim and M. Okamoto
- P-10 The Effect of Triblock Copolymer on Viscoelastic Properties of Immiscible Blends ..... 310  
W. Klinklai, A. Srivat and A.M. Jamieson
- P-11 Preparation of Rubber Foam by Blending Graft Copolymer of Deproteinized Natural Rubber and Methyl Methacrylate (DPNR-g-MMA) and Natural Rubber Latices ..... 313  
C. Nakason, A. Kaesaman and K. Kesarin
- P-12 Phase Separation Morphology in Poly(methyl methacrylate)/  
Poly(styrene-co-maleic anhydride) Blend ..... 316  
P. Rojanapitayakorn, S. Thongyai and S. Wacharawichanan
- P-13 *Pseudo* Liquid Crystalline PEN ..... 319  
S.H. Kim and D.J. KIM
- P-14 A Study of NR/PVC Blends ..... 321  
W. Sukkaew, J. Woothikanokhan and N. Thavarungkul
- P-15 Copolymers as Compatibilisers in LDPE/PS Blends ..... 322  
C. Ritvirulh, A.J. Ryan and A.N. Wilkinson

P-16	Conductive Nano-composite of PEDOT/silicate .....	325
	Y. Lee, J.H. Lee and Y. Son	

### **SYMPORIUM III : *Extrusion and Extrusion-Based Process***

P-17	Influence of Molecular Weight and Molecular Weight Distribution on Processability and Mechanical Properties of Polyethylene Homopolymer Blends .....	327
	A. Pongsuk and R. Magaraphan	
P-18	Studies on Temperature Profiles of Flowing Polymer Melts in a Twin Screw Extruder .....	330
	M. Panapoy and N. Sombatsompop	
P-19	Development of Biaxially Oriented Polyamide 6 and 612 Films by Double Bubble Tubular Film Extrusion .....	333
	S. Rhee and J.L. White	
P-20	Optimization of the Drawing and Annealing Conditions for Improving the Mechanical Properties of Poly (L-lactide-co-ε-caprolactone) Monofilament Fibres for Potential Use as Absorbable Sutures	336
	J. Siripitayananon, R. Molloy, N. Molloy, A. Wongarsa, M. Sriyai, M. Srisa-ard, A. Charuchinda, P. Muhammed and K. Na Lampang	
P-21	Effect of Corona Treatment on Adhesion and Mechanical Properties of Laminated Polyolefin Films	339
	P. Somboonviwat, W. Chinsirikul and W. Udomkichdhesha	

### **SYMPORIUM IV : *Rubber Processing***

### **SYMPORIUM V : *Injection Molding***

P-22	Measurements of Temperature Distributions of Unfilled and Glass-Fibre Filled Polymer Melts in Injection Moulding .....	340
	N. Sombatsompop, S. Patcharaphun and W. Chaiwattanipat	
P-23	Factors Affecting Adhesion of Polymers During Coinjection .....	343
	W. Rungseesantivanon and G.F. Smith	
P-24	Parts Quality Prediction Based on Cavity Variables .....	349
	I.H. Shin, J.G. Kim and J.W. Lee	
P-25	DMTA Studies of Drawn PEs and PP .....	352
	S. Thumsorn and N. Thavarungkul	
P-26	Fibrillation Behavior of Man-made Cellulosic Fibers under Microscopic Examination .....	353
	S. Chiarakorn and W. Udomkichdecha	

### **SYMPORIUM VI : *Computational Modeling and Simulations in Polymer Processing***

P-27	Numerical Simulation of the PP-GMT Compression Molding .....	354
	L. Zhang and G. Dai	
P-28	Unusual Mechanical Properties of Injection Molded Parts Reinforced with Short Fibers .....	357
	S. Oldrich, Z. Milan and M. Miroslav	

## **SYMPORIUM VII : Polymer Recycling**

- P-29 Glycolysis Reaction Kinetics of Polymeric MDI-Based Rigid Polyurethane Foams ..... 360  
J.Y. Lee and D.J. Kim
- P-30 Mechanical Properties of Polypropylene and Nylon-6 Blends from Recycled Toothbrushes with a Compatibilizer ..... 362  
S. Woramongconchai and W. Mingmaung
- P-31 Study of the Properties of Plastic Crates Used for Soft-Drink Bottle Transportation for Recycling Purpose ..... 364  
S. Ngamsinlapasathian and S. Damrongsakkul

## **SYMPORIUM VIII : Rheology**

- P-32 Rheological Behavior of Ceramic Injection Molding Mixtures ..... 365  
K. Okada and Y. Nagase
- P-33 Turbulent Drag Reduction of Polyacrylamide and 70% Hydrolyzed Polyacrylamide Solutions ..... 368  
W. Chonkaew and A. Sirivat
- P-34 Effects of Temperature and Molecular Weight on Binding Between Poly(ethylene oxide) and a Cationic Surfactant in Aqueous Solutions ..... 371  
K.Y. Mya, A. Sirivat and A.M. Jamieson
- P-35 Flow Properties of Molten Polymers in Mobile Barrel Capillary Rheometer ..... 374  
N-T Intawong and N. Sombatsompob
- P-36 Molar mass Dependence of Rheological Characterization of Elastomers Using A Compression-Relaxation-Recovery Test ..... 377  
S. Puttajukr, J.F. Tassin, J.L. Mary and G. Boccaccio
- P-37 Time-Resolved Light Scattering Analysis of Onset of Foaming in Polystyrene/ CO<sub>2</sub> System ..... 380  
S. Arerat, M. Ohshima and M. Tanigaki
- P-38 Interactions of Hydroxypropylcellulose with Octyl-β-D-1-thioglucopyranoside and Cetyltrimethylammonium Bromide as Studied by Dynamic Light Scattering and Viscosity Measurements ..... 383  
P. Hormnirun, A. Sirivat and A.M. Jamieson
- P-39 Dynamic Mechanical Properties of Raw Natural Rubber ..... 385  
V. Noparatanakailas and M. Seadan
- P-40 Viscosity Measurement of Novel Polymers and Additives using a Conical Micro Twin-screw Compounder ..... 388  
S.R. Kim

## **SYMPORIUM IX : Composites**

- P-41 Effects of Silanol Groups on the Formation of Bound Rubber in Silica Filled Rubber ..... 390  
S. Ono and M. Ito
- P-42 Effects of Processing Conditions of Injection Molding on The Microstructure of Long Fiber Reinforced Nylon Composites ..... 392  
J.H. Park, W.N. Kim, S. Lim, M.B. Ko and C.R. Choe

P-43	Organic/Inorganic Composite Materials for Coating Applications .....	395
	R. Chareonsak, J.-I Chen, V. Puengpipat and S. Marturunkakul	
P-44	Preparation and Characterisation of Poly(Glycidyl Methacrylate-co-Methyl Methacrylate) /Clay Hybrids .....	398
	N. Manomaisantiphap, A. Tabtiang and R.A. Venables	
P-45	Effect of Interfacial Adhesion on The Morphology and Properties of Polypropylene Composites ....	400
	I. Preechachon, S. Chalermthitipa and K. Premphet	
P-46	Properties Improvement of Sand Bonded with Phenolic Resin Composites using Resin Blends of Thai Produced and Imported Resins: Application for Shell Molding in Thai Foundry Industry ....	403
	U. Oenggaew, S. Chuayjuljit, W. Chinsirikul and J. Pearce	
P-47	Plasma Surface Modification of Kevlar Short Fibers/ABS Composites .....	407
	I. Jangchud, B. Sukying and S. Limcharoen	
P-48	Study of Biodegradable Polymers from Natural Fillers : Wheat Gluten, Soy Protein, Peanut Protein and Sodium Caseinate .....	410
	I. Jangchud, L. Wongkampoo, S. Pichadkitjawat and A. Jangchud	
P-49	A Study of Hygrothermal and Thermal-cycling Environmental Conditions in Thermoset Composites Utilization .....	413
	I.-K. Park and J.-D. Nam	

#### **SYMPORIUM X : *Blow Molding , Rotomolding and Thermal Forming***

P-50	Extrusion Blow Moulding of CaCO <sub>3</sub> - Filled HDPE Compounds .....	415
	S. Jumpa and B. Haworth	

#### **SYMPORIUM XI : *Mixing and Compounding***

P-51	Comparative Studies of the Effect of Compatibilizers on HDPE/Nylon 6 Blends .....	418
	W. Kirdudom, S. Chotiwan and V. Thammongkol	
P-52	Effect of Fillers on Oxygen Barrier Properties of High Density Polyethylene .....	421
	R. Yeetsorn, S. Chotiwan and V. Thammongkol	
P-53	A Study of Filler Distribution in BR/NBR Blends .....	424
	N. Prayoonchatphan and C. Sirisinha	
P-54	A Mixing Study of Carbon Black Filled SBR Compounds: Effect of State-of-Mix on Tensile Properties, Dynamic Properties and Rheological Properties .....	427
	W. Sittichokchuchai and C. Sirisinha	
P-55	Effect of beta-Nucleator and Compounding/Processing Conditions on Mechanical Properties of Isotactic Polypropylene Films .....	430
	T. Meesane, W. Chinsirikul and K. Khemachantara	

#### **SYMPORIUM XII : *Other Categories***

P-56	Preparation and Characterization of Polypyrrole Films for Gas Sensor Application .....	431
	W. Prissanaroon and A. Sirivat	

P-57 Development of Pyroelectric Sensor Devices Using Poly(Vinylidene Fluoride) .....	434
P. Santiwitayanon, A. Techagumpuch and K. Ratanathammapan	
P-58 Isothermal Crystallization and Melting Behavior of Syndiotactic Polypropylene .....	437
P. Supaphol, J.E. Spruiell and J.-S. Lin	
P-59 Effect of Moisture on the State of Stress of Photographic Gelatin-Latex Coatings .....	442
D. Aht-Ong and R.J. Farris	
P-60 A New Convenient Approach to Determine HCl Gas Generation from Combustion of PVC .....	446
Y. Zhang, S. Zhu, Z. Peng, Y. Zhang and X. Zhang	
P-61 A Development of a Ribbed Smoked Rubber Sheet Punching Machine for Removing Impurity ....	448
K. Sathirakul, W. Chinsirkul, S. Madarasmi and S. Leeraphan	
<b>Author-Paper Index.....</b>	<b>450</b>

# T E C H N I C A L P R O G R A M

## S Y M P O S I A

The total number of oral and poster presentations of the following topics are 148 contributions.

Symposium	Oral Presentation Room (No of paper)	Poster Presentation Charoennakorn room (No of paper)
Reactive Processing	Room A (9)	(2)
Polymer Blends and Alloys	Room A (13)	(14)
Extrusion and Extrusion-based Process	Room B (10)	(6)
Rubber Processing	Room B (3)	
Injection Molding	Room B (9)	(5)
Computational Modeling and Simulations	Room C (7)	(2)
Polymer Recycling	Room C (6)	(3)
Rheology	Room C (9)	(9)
Composites	Room D (9)	(9)
Blow Molding, Rotomolding and Thermal Forming	Room D (4)	(1)
Mixing and Compounding	Room D (8)	(5)
Other Categories	-	(6)

## C O N F E R E N C E S C H E D U L E

December 1

Time	Events	
09.00 - 09.30	Room A Opening Ceremony	
09.30 - 09.35	A Tribute to Professor Morand Lamble	
09.35 - 09.55	Polymer Industry in Thailand	
09.55 - 10.45	Christopher W. Macosko, University of Minnesota, USA. Creating Block Copolymers via Melt Coupling Reactions	
10.45 - 11.00	Refreshment	
11.00 - 11.50	James L. White, The University of Akron, USA. Twin Screw Extrusion: Technology, Science, Analysis and Design	Poster Presentations
11.50 - 13.30	LUNCH	POSTER ON-SITE DISCUSSION (P-1 to P-32)
13.30 - 14.10	Leszek A. Utracki, National Research Council of Canada, Canada Compounding and Mixing of Polymer Blends	
14.10 - 14.50	John Vlachopoulos, McMaster University, Canada Recent Technological Developments and the Computer Simulation of the Film Blowing Process	
14.50 - 15.05	Refreshment	
15.05 - 15.25	Room A	Poster Presentations
15.25 - 15.45		
15.45 - 16.05	Reactive Processing A-1 to A-6	
16.05 - 16.25	Room B	
16.25 - 16.45	Extrusion B-1 to B-5	
16.45 - 17.05	Room C	
17.05 - 17.35	Computational Modeling C-1 to C-5	
	Room D	
	Composites D-1 to D-6	
	End of Oral Session	POSTER ON-SITE DISCUSSION (P-1 to P-32)

# TECHNICAL PROGRAM

**December 2**

Time	Events	Poster Presentations
09:00 - 09:40	<b>Room A</b> Toshio Masuda, Kyoto University, Japan Rheological Characterization of Structure Developments in Polymer Melts	
09:40 - 10:20	Ian R. Harrison, The Pennsylvania State University, USA Virtual Instruments in Plastic/Polymer Education: Blown Film Extrusion	
10:20 - 11:00	Ami K. Bhownisk, Indian Institute of Technology, India Novel Thermoplastic Elastomers from Blends of Rubbers and Plastics	
11:00 - 11:15	Refreshment	
11:15 - 11:35	<b>Room A</b> Reactive Processing A-7 to A-9	
11:35 - 11:55	<b>Room B</b> Extrusion B-6 to B-8	
11:55 - 12:15	<b>Room C</b> Computational Modeling C-6 to C-7	
12:15 - 13:30	<b>Room D</b> Composites D-7 to D-9	
13:30 - 14:10	LUNCH	POSTER ON-SITE DISCUSSION (P-33 to P-61)
14:10 - 14:50	<b>Room A</b> Chul Rim Choi, Korea Institute of Science and Technology, Korea Multiphase Toughened Epoxy as Composite Matrix Design and Selection of Tougheners	
14:50 - 15:30	Sung Chul Kim, Korea Advanced Institute of Science and Technology, Korea Polymer Alloys with Morphology Spectrum Graeme Churchward, Royal Melbourne Institute of Technology, Australia Strategies for Effective Melt Reprocessing-Case Studies including Polypropylene Postconsumer Waste, Tyre Crumb Composites, Stretch Film and Expanded Polyethylene	
15:30 - 16:45	Refreshment	Poster Presentations
16:45 - 16:55	<b>Room A</b> Polymer Blends and Alloys A-10 to A-14	
16:55 - 17:05	<b>Room B</b> Extrusion B-9 to B-10	
17:05 - 17:25	Rubber Processing B-11 to B-13	
17:25 - 17:45	<b>Room C</b> Polymer Recycling C-8 to C-13	
17:45 - 18:15	<b>Room D</b> Blow Molding D-10 to D-13	
	End of Oral Session	POSTER ON-SITE DISCUSSION (P-33 to P-61)

**December 3**

Time	Events	Poster Presentations
09:00 - 09:40	<b>Room A</b> Gordon F. Smith, University of Warwick, UK Technology Breakthroughs in the Production of Injection Moulded Components	
09:40 - 10:20	Swie Bin Teoh, National University of Singapore, Singapore Computer Aided Rotational Moulding and Thermoforming of Medical Devices	
10:20 - 10:35	Refreshment	
10:35 - 10:55	<b>Room A</b> Polymer Blends and Alloys A-16 to A-18	
10:55 - 11:15	<b>Room B</b> Injection Molding B-14 to B-17	
11:15 - 11:35	<b>Room C</b> Rheology C-14 to C-17	
11:35 - 11:55	<b>Room D</b> Mixing D-14 to D-17	
11:55 - 13:30	LUNCH	
13:30 - 14:10	<b>Room A</b> Ica Mana-Zlozower, Case Western Reserve University, USA Influence of Design on Mixing Efficiency in Polymer Processing Equipment	
14:10 - 14:50	Ta-Jo Liu, National Tsing Hua University, Taiwan ROC A Review on the Theoretical Tools for Extrusion Die Design	
14:50 - 15:00	POSTER AWARD ANNOUNCEMENT	
15:00 - 15:15	Refreshment	
15:15 - 15:35	<b>Room A</b> Polymer Blends and Alloys A-19 to A-22	
15:35 - 15:55	<b>Room B</b> Injection Molding B-18 to B-22	
15:55 - 16:15	<b>Room C</b> Rheology C-18 to C-22	
16:15 - 16:35	<b>Room D</b> Mixing D-18 to D-21	
16:35 - 16:55		

# CONFERENCE COMMITTEE

## C onference Committee

**Chairman:** *Krisda Suchiva*, National Metal and Materials Technology Center  
**Secretariat:** *Wanee Chinsirikul*, National Metal and Materials Technology Center  
*Asira Fuongfuchat*, National Metal and Materials Technology Center  
**Technical Program:** *Anuvat Sirivat*, The Petroleum and Petrochemical College, Chulalongkorn University  
**Social Program:** *Khemchai Hamachandra*, Chulalongkorn University  
**Members:** *Banleng Sornil*, King Mongkut's Institute of Technology North Bangkok  
*Chakrit Sirisinha*, Mahidol University  
*Ittipol Jangchud*, King Mongkut's Institute of Technology Ladkrabang  
*Jatuphorn Wootthikanokkhan*, King Mongkut's University of Technology Thonburi  
*Kanyanee Premphet*, Mahidol University  
*Manas Saedan*, Prince of Songkla University  
*Narongrit Sombatsopop*, King Mongkut's University of Technology Thonburi  
*Pasaree Laokijcharoen*, National Metal and Materials Technology Center  
*Supon Chotiwat*, King Mongkut's Institute of Technology North Bangkok  
*Varun Taephaisitphongse*, Chulalongkorn University  
*Werasak Udomkichdecha*, Chulalongkorn University

### Plastic Industry Club

**Representatives:** Nam Cholsaipan  
Pailin Chuchottaworn  
Thanee Puttipanpluck

## PS Executive Committee (1999 - 2001)

**President :** G. Vassilatos, USA  
**Secretary :** D. Bigio, USA  
**Treasurer :** T.A. Osswald, USA  
**Past-president :** S.C. Kim, Korea  
**Members at large :** T. Sakai, Japan  
A.J. Ryan, UK  
K. Funatsu, Japan  
G. Titomanlio, Italy  
**Editor-in-Chief, IPP :** J.L. White, USA  
**Editor, PPP :** K.S. Hyun, USA

## I nternational Representatives

S. F. Bush (UK)	J. Covas (Portugal)	J.M. Haudin (France)
A.N. Hrymak (Canada)	T. Kikutani (Japan)	I. Manas-Zloczower (USA)
H.E.H. Meijer (Netherlands)	A. Misra (India)	L. Nicolais (Italy)
H. Potente (Germany)	P. Saha (Czech Republic)	K. Suchiva (Thailand)
S.H. Teoh (Singapore)	X. Xu (China)	