TENSILE PROPERTIES OF CALSIUM CARBONATE FILLED POLYPROPYLENE BLOK COPOLYMER COMPOSITE PIPES

A. Altay[1], H. Akten[2] and Ş. Şahin[3*]

[1]*Altınay Robot Teknolojileri, Tuzla, Istanbul, Turkey - anilaltay@gmail.com*
[2]*Department of Mechanical Engineering, Kocaeli University, Turkey - handeakten@gmail.com*
[3*]Department of Mechanical Engineering, Kocaeli University, *Turkey - sensah@kocaeli.edu.tr*

Abstract - In this experimental study, according to the ISO 6259-1, calcium carbonate (CC) filled polypropylene block copolymer (PPB) the diameter of the pipe circumference and length of pipe. PPB composite pipe along standard test sample is used in pure and micro-particulate substance -filled thermoplastic materials for comparison of uniaxial tensile properties. Standard test sample is usually produced with injection molding and/or hot pressure methods. Otherwise, thermoplastic pipes filled with pure and micro-particulate substance are obtained with single-screw extrusion method, continuous production. In this method, great head (forming) force cannot be applied such as injection molding and/or hot-pressing methods. In this context, the purpose of this study determine PPB pipes filled with pure and CC micro-particle sized, pure and filled with CC micro-particle sized PPB pipes, both compare the features of both uniaxial tensile and determine the effect of the amount of filler. According to the ISO 6259-1, produced by single-screw extrusion method, which is the outer diameter of 75 mm and wall thickness 6.8 mm pure PPB and different volume per cent (vol.%) 10, 20 and 30 in the amount of filled PPB- composite pipes uniaxial tensile test was performed along the diameter of the pipe circumference and length of pipe. The experimental results showed that, as a regional uniaxial tensile property are partly the same along the diameter of the pipe circumference and length of pipe. Furthermore, based on the pure PPB pipe have been identified, while PPB/CC composite pipe Young's module depending on the amount.

Keywords: Composite pipe, Tensile properties, Calcium carbonate, Filled.

Introduction

The semi-crystalline thermoplastics and the applications that filled with various micro particles of these have been subjected to numerous studies. Many researches accomplished to understand the deformation characteristics of these thermoplastic materials [1]. Thermoplastic materials were manufactured by using CC [2] in different particle sizes with physical modification and weight percentage (wt %) amounts. To analyze the uniaxial mechanical properties and investigating the CC particle size [3] and content effect [4] to these thermoplastic materials, high pressurized methods are used like injection molding and hot pressing, similar to their regular manufacturing methods.

In this context, the purpose of this study determine PPB pipes filled with pure and CC micro-particle sized, pure and filled with CC micro-particle sized PPB pipes, both compare the features of both uniaxial tensile and determine the effect of the amount of filler.

Experimental

Materials

In this study, the polypropylene block copolymer (PPB) has been used, which commercial name is BorECO™ BEC5015 (Borealis A/S) and has 900 kg/m3 density and 0.30 g/10 min (230oC/2.16 kg) melting flow rate. The values of manufacturer is 1500 MPa modulus of tensile, 30 MPa yield stress and 10% yield strain about some mechanical properties for released pipe material in the unpressurized pipe systems according to ISO527 standard (Borealis 22.01.2008 Ed.9). To analyze the amount of filler, calcium carbonate has been used, which commercial name is Mikrocarb-5 (Mikro Mineral Endüstriyel Mineraller San. ve Tic. A.Ş.), average particle size has been 5.00 μm, and density has been 2700 kg/m3. The values of manufacturer about results of the analysis, CC material in the white and powder form particle size distribution is in the Table 1.

Table 1 Particle Size Analysis Results (Mikro Mineral 2004 Rev: 03)

Particle Size	Method	Unit	Typical Value
Mean dia., d (0.5)		μm	5.00
Top Cut, d (0.97)		μm	28.00
Below 2 μm [min.]		%	30
Sieve 45 μm [max.]	ISO787-7	%	0.1

Composite Preparation

For the PPB / CC composite production, twin-screw extruder (Coperion Werner and Pleiderer ZSK 70 Mcc) has been used that has (L/D) 38.5, screw length (L) 2700 mm. With the physical modification, CC filled PPB/CC composite raw materials has been produced in three different percent by volume 10%, 20% and 30% (25.00%, 42.86% and 56.25% by weight). The production has been performed which settings have been minus 1 bar vacuum pressure, 750 rpm (1/min) rotation speed, 500 kg/h production capacity; between 220°C and 245°C zone temperature and 30°C cooling water bath. Each composite has been performed dried at 50°C for 4 hours.

Composite Pipe Extrusion

According to SDR (Standard dimension ratio) 11, for the production of outer diameter of 75 mm pipes, single screw extruder (Krauss-Maffei KME 60-36 B /

R) has been used, which has screw length (L/D) 36, screw diameter (D) 60 mm. The pure pipe has been extruded between 200°C and 260°C zone temperatures and at 25°C cooling water. But, CC filled PPB/CC composite pipes have been able to extruded (produced) 10, 20 and 30 percent by volume, between at 210°C and 220°C, 195°C and 190°C, 180°C and 180°C zone temperatures (with the same line) and at 25°C cooling water.

Test Specimen Preparation

Firstly, the pure PPB and PPB/CC composite pipes, which have been produced with single-screw extrusion method, have been stored in the place with comfort conditions that not reach solar radiation at least 50 months but can be exposed to daylight. After that, according to ISO 6259-1, according to ISO 3167 standard 220 mm x 10 mm x e mm ("e" thickness that of the pipe) sized Type 1A multi-purpose test specimens have been obtained over the pipes, along the length of pipe and from 5 areas of pipe diameter circumference. To obtain a multi-purpose test pieces, cut (punch) mold has been used for the multi-purpose test piece dimensions according to Type 1-A that given in the ISO 3167 standard. Measurements of the width and thickness of the test piece multi-purpose has been made with digital caliper (Mitutoyo) that has 0.01 measurement sensitivity.

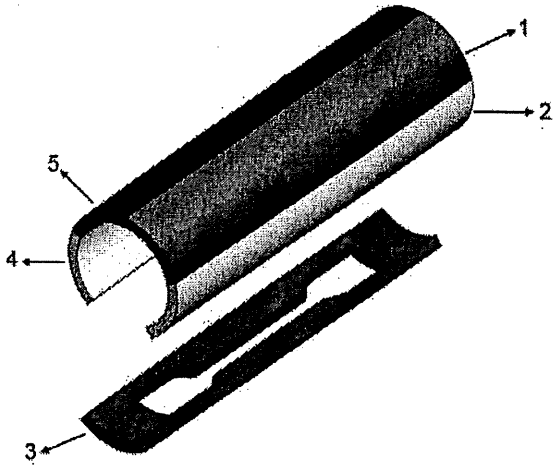


Figure 1 Multi-purpose test specimen

Tensile Test

Tensile tests were done considering ISO 527-1 with a tensile testing machine (INSTRON 4411 H 4240) which has a capacity of 5 kN with Clip-on static extensometer (INSTRON 2630-111) and Bluehill-2 version.2.6 software on it. According to ISO 527-2 standard 216 mm x 10 mm x e mm sized Type 1A tensile samples were placed in the tensile test machine. In test process 1 mm/min. tensile jaw speed used to define the Young's Modulus and 50mm/min. for other properties. Tests were done under 22°C ± 1°C temperature and 50±10% humidity and for each value at least 10 test specimens were used. Obtained values were statistically considered according to Chauvenet Criteria [5]. Results are shown in graphics based on values obtained from pure PPB pipe and changes in tensile properties are shown in graphics depending on different percentages of volume.

Results and Discussion

Note that in case that in this study, the pure PPB raw material has been used without being exposed to the effects of twin-screw extrusion parameters such as PPB/CC composite materials. Also, different extrusion parameters (zone temperatures etc.) has been used to produce both pure PPB pipes and CC filled PPB/CC composite pipes, which 10, 20 and 30% by volume (25.00, 42.86 and 56.25 % by weight) with single-screw extrusion method. The data's examined and plotted from the uniaxial tensile test that applied to the SDR 11, D 75mm pipe sections shown in Fig. 1 Young's modulus shown in Fig. 2, tensile stress shown in Fig. 3, tensile strain shown in Fig. 4, tensile stress at break shown in Fig. 5 and elongation at break shown in Fig. 6.

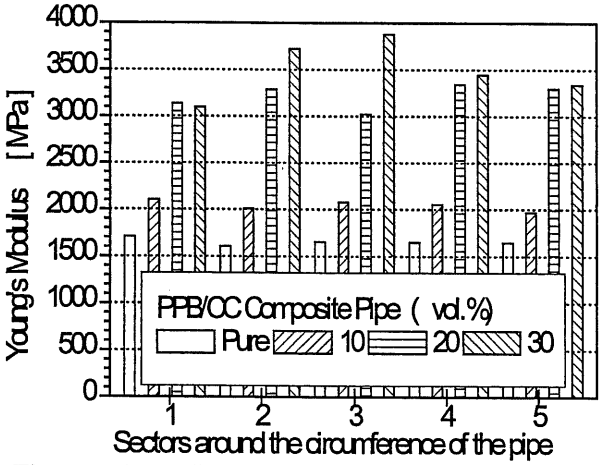


Figure 2 According to SDR11, to change of Young's module that D_O=75 mm, pure PPB and d(0.5) = 5 μm CC material and 10, 20 and 30 percentage by volume filled PPB/CC composite pipes.

When Fig. 2, has been examined, it was shown firstly; Young's module of the pure PPB pipe was increased with extra CC filled amount 10% by volume. After that, Young's module of the PPB/CC composite pipe was improved more with increasing CC filler content. Then, it was detected that Young's module value of the pure PBB pipe did not change according to sectors around of the pipe circumference. Also, it was detected that the Young's Module value of 10% by volume CC filled PPB/CC composite pipe did not change sectors around of the pipe circumference but increased CC filled amount PPB/CC composite pipes, the Young's Module has been changed sectors around of the pipe circumference.

When Fig. 3 was examined, firstly it was shown that it is inversely proportional with the changes in tensile stress (at yield) of pipes depends on CC filled amount (Fig. 2) and the changes of Young's module of pipes depends on CC filled amount. Then, it was shown that the yield stress of pure PPB pipe has been decreased with extra CC filled amount 10% by volume. Then by,

the tensile stress of PPB/CC composite pipe has been decreased more with extra CC filled amount. Finally, it was confirmed that the pure PBB pipe and tensile stress values of CC filled composite pipes with 10, 20 and 30% by volume did not change according to sectors around of the pipe.

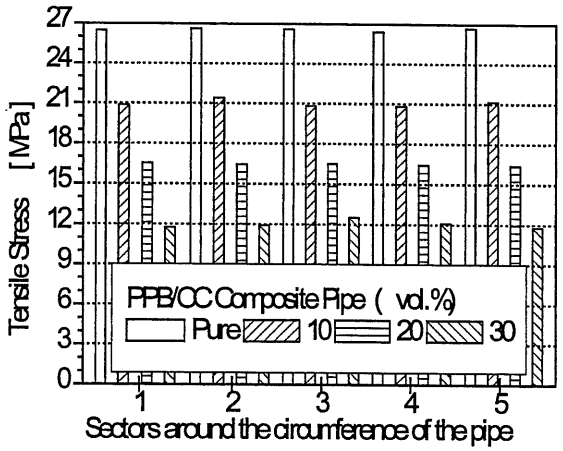


Figure 3 According to SDR11, to change of tensile stress of pure PPB and 10, 20, 30% by volume filled PPB/CC composite pipes that has D_O=75 mm.

When Fig. 4 was examined, firstly it was shown that the changes in the tensile strain (at yield) depends on CC filled amount (Fig. 3) is similar with the changes in the tensile stress depends on CC filled amount. But here, it was established that the changes in the tensile extension values of pipes sectors around of the pipe circumference were similar with the changes the Young's module values of pipes (Fig. 2) according to sectors around of the pipe circumference, with only a change. It was observed , when the tensile stress values of pure PBB and 10 percentage by volume CC filled PPB/CC composite pipes changed according to parts of the pipe circumference, but in PPB/CC composite pipes that the amount of CC filled is more, the tensile stress values did not change sectors around of the pipe circumference.

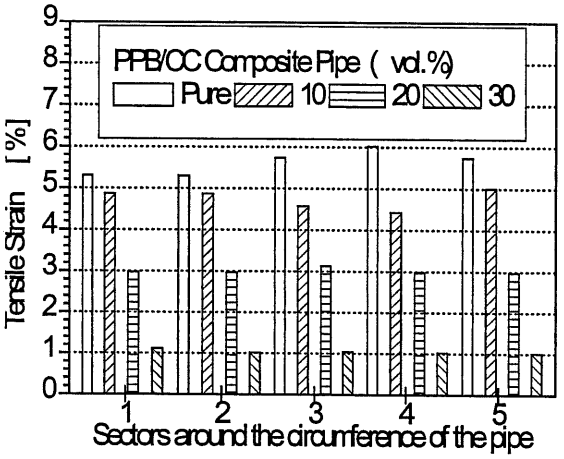


Figure 4 According to SDR11, to change of yield extension of pure PPB and 10, 20, 30 percentage by volume filled PPB/CC composite pipes that has D_O=75 mm.

When Fig. 5 was examined, firstly it was observed that the changes in the tensile stresses of the pipe according to CC filled amount are similar with the changes of tensile stresses (Fig. 3) of the pipe according to CC filled amount. But also here, it was detected that the changes tensile strength values of pipes sectors around of the pipe circumference are similar with the Young's module (Fig. 2) of the pipes sectors around of the pipe circumference.

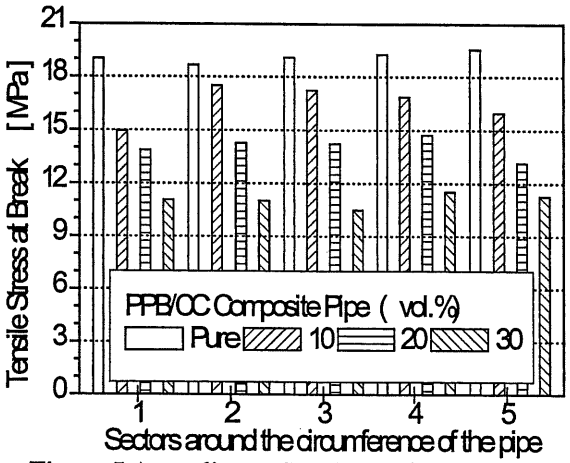


Figure 5 According to SDR11, to change of tensile strength of 10, 20, 30 percent of volume CC filled PPB/CC composite pipes , which have D_O=75 mm, pure PPB and d(0.5) = 5 μm.

When Fig. 6 was examined, firstly it was shown that the changes breaking elongations of pipes according to CC filled amount are similar with the changes tensile stresses, tensile strains and breaking stresses of pipes (Fig. 3, Fig. 4 and Fig. 5) according to CC filled amount.

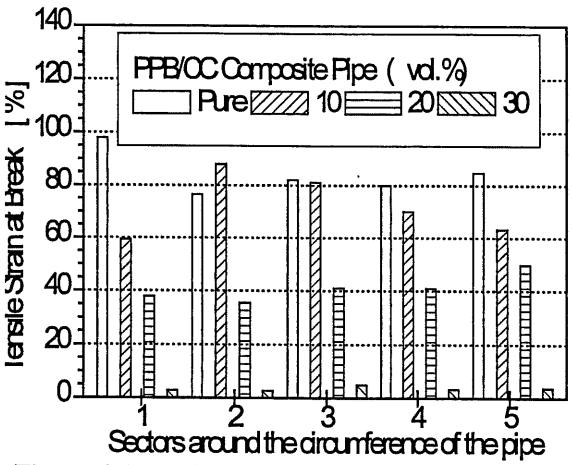


Figure 6 According to SDR11, to change of breaking elongation of 10, 20, 30 percentage of volume CC filled PPB/CC composite pipes, which have D_O=75 mm, pure and d (0.5) = 5 μm.

But also here, it could be said that the changes at breaking elongation values of pipes according to sectors around of the pipe circumference –perhaps only for 30 % by volume CC filled PPB/CC composite pipe- did not change because of very small values. It was determined that the breaking elongation values of other pure PPB and 10 and 20% by volume CC filled composite pipes have a change non-regular according

to sectors around of the pipe circumference. Moreover, it was determined that breaking elongation values of 10% by volume CC filled PPB/CC composite pipe's some areas are very closed or greater values at breaking elongation of pure PPB pipe.

Conclusions

In this study, according to ISO 6259-1, uniaxial tensile properties of 10, 20 and 30 % by volume (25.22, 42.86 and 56.25 % by weight) average particle size 5 μm CC filled PPB/CC composite pipes, which have 75 mm outer diameter and pure PPB pipes produced with single-screw extrusion method and were stored in the place open to daylight with comfort conditions but not exposed to direct sunlight at least 50 months was investigated. Uniaxial tensile properties of pipes were determined according to pipe circumference. The experiments were brought out the fact that CC filler content affected the uniaxial tensile properties of PPB / CC composite pipe according to ISO 6259-1.It was determined that 10% by volume CC content has been increased the Young's Module of pure PPB pipe. On the other hand, yield stress, yield strain, breaking stress and breaking elongation of pure PPB pipe has been decreased. It was determined that after increasing at 10 % by volume CC content was getting increased the Young's Module of the PPB/CC pipe. In spite of this, yield strain, yield stress, breaking stress and especially breaking elongation were getting decreased. All the samples are manufactured by high pressurized injection molding or hot press methods that can be defined like this; the samples are generally gets cold and take the molds shape, therefore according to related studies a significant similarity in the results was observed. Furthermore, the Young's Module and tensile stress values of 10% by volume CC filled PPB/CC composite pipe didn't change according to part of the pipe circumference, but in the PPB/CC composite pipes which have more CC content, the Young's Module value has changed according to part of the pipe circumference, but yield stress has not changed. It was determined that the tensile strain values of pure PBB and 10% by volume CC filled PPB/CC composite pipes have been changed at the sectors around of circle circumstance, but PPB/CC composite pipes which have more CC content, the tensile stress values has not been changed at the sectors around of circle circumstance. It was determined that the changes in breaking stress values of pipes according to sectors around of the pipe circumference were similar with Young's Module values of pipes according to sectors around of the pipe circumference. In the future studies about PPB/CC composite pipes, it should be considered to prefer less average particle size and/or less CC content and/or hydrophobic featured CC materials and different production parameters.

Acknowledgements

This study was performed to utilize the pipes which remained after the completed project of The Scientific and Technological Research Council of Turkey (TUBITAK) with title of "Optimization of Short and Long Term Internal Pressure Performance Properties of Polyolefin Pipes with Mineral Fillers", (project number: 105M220).
The author would like to thank to "EMAŞ Plastik San. ve Tic. A.Ş." for helping in the process of raw material production and also to "IBG-Pakplastik Plastik Yapı Elemanları San. ve Ticaret A.Ş." for their outstanding efforts in single screw pipe extrusion process.

References

1. Y. Zhou, P.K. Mallick: Polym. Eng. Sci. 42, 12, (2002) 2449.
2. W.C.J. Zuiderduin, C. Westzaan, J. Hue'tink, R.J. Gaymans: Polymer 44 (2003) 261.
3. Q. Wulin, K. Mai, H. Zeng: J. Appl. Polym. Sci. 77 (2000) 2974.
4. C.A. Wah, L.Y. Choong, G.S. Neon: Eur. Polym. J. 36 (2000) 789.
5. J.P., Holman, Experimental Methods for Engineers, 6th Ed., McGraw-Hill, (1994).

Abstracts

General Symposia

S01 - Mixing and Compounding 1
S02 - Films and Fibers 13
S03 - Processing and Forming (Combined)* 26
S04 - Injection Molding and Molds 42
S05 - Rheology and Rheometry 61
S06 - Polymer Nanostructures and Nanocomposites 73
S07 - Natural Based and Biodegradable Polymers 107
S08 - Polymer Foams 125
S09 - Polymer Composites 137
S11 - Elastomers and Thermoplastic Elastomers 163
S12 - Modeling and Simulation 171
S13 - Polymer Blends 188
S14 - Reactive Processing 202

Special Symposia 210

S15 - Plastic Solutions for Renewable Energy Technologies
S16 - Plastic Solutions for E-mobility
S17 - Plastic Solutions for Construction and Housing
S18 - Additive Manufacturing for Plastic Components
S19 - Manufacturing of Load-Carrying Hybrid Polymer Structures
S20 - Microtribology and Surface Analysis
S21 - DRG: Fundamental and Applied Rheology
S22 - Thermo-Mechanically Graded Materials

** The two symposia "Extrusion, joining, and coating" as well as "Blow molding, Thermoforming, and Rotomolding" have been combined.*

S07-936 **Preliminary Studies On The Enhancement Of PLA Melt Strength**
Carbone Maria Josefina, Van Puyvelde Peter*

S08 - Polymer Foams

S08-278 **Prediction Of An Effective Physical Foamability Of LLDPE/LDPE Blends From Rheological Assessments**
Cardoso Elisabeth Carvalho Leite, Scagliusi Sandra Regina, Lugão Ademar Benevolo*

S08-310 **Surface Modification Of Polypropylene Based Particle Foams**
Schreier Peter, Altstädt Volker, Trassl Christian*

S08-320 **Use Of The Bottom Phase Residue From Polyurethane Glycolysis As Polyol Polymerisation Initiator**
Simón Herrero Diego, Borreguero Simón Ana María, de Lucas Martínez Antonio, Molero Cerezo Carolina, Rodríguez Romero Juan Francisco*

S08-324 **Effect Of The Microencapsulated PCMs Type On Rigid Polyurethane Foams Properties**
Borreguero Ana Maria, Carmona Manuel, Rodriguez Juan Francisco, Valverde Jose Luis*

S08-511 **Rheology Of Polystyrene Dissolved In Monoterpenes**
Machado Ricardo Antonio Francisco, Cella Rafael Ferraz, Bolzan Ariovaldo*

S08-573 **An Experimental Apparatus To Characterize Phase Separation In Polymer Solutions**
Mannella Gianluca Antonio, La Carrubba Vincenzo, Brucato Valerio*

S08-597 **Foaming Of Recycled Cross-linked Low Density Polyethylenes Via Supercritical Fluid Reactions**
Hong Soon Man, Baek Bumki, Shin Jiwook, Koo Chong Min*

S08-763 **Development Of Polymer Wicks For EEG Electrodes**
Martins Ana C., Mota Armando R., Nobrega Joao Miguel, Fonseca Carlos, Machado Ana Vera, Vaz Filipe*

S08-775 **Potential Of Carbon-Based Nanoparticles (CNT, CB, Graphene) To Increase The Nucleation Density Of Extruded Polystyrene Foams**
Okolieocha Chimezie , Altstädt Volker*

S08-821 **Foam Injection Molding Of Thermoplastic Elastomers: Blowing Agents, Foaming Process And Characterization Of Structural Foams**
Ries Stefan, Spörrer Andreas, Altstädt Volker*

S08-882 **Chemical Resistance Of Core-Shell Particles (PS/PMMA) Polymerized By Seeded Suspension**
*Ribeiro Luiz Fernando, Antunes Mariana Zimmermann, Gonçalves Odinei Hess, Machado Ricardo Antonio Francisco**

S09 - Polymer Composites

S09-1 **Single Polymer Composite Made Of Polypropylene Fabric And Matrix**
*Agrawal Bhawana**

S09-118 **Tribological Properties Of PTFE Composite Films Filled With Carbon Nanofiber**
Enomoto Kazuki, Yoshikawa Shigeki, Hirabayshi Masanori*

S09-135 **Role Of Different Compatibilizing Approaches On The Microstructure And Mechanical Properties Of Polypropylene/Talc Composites**
Homayounfar Seyedeh Zohreh, Bagheri Reza*

S09-169 **Reuse Of Rigid Polyurethane Foam As Filler For Polypropylene Matrix**
Souza Adriana M. Catelli, Melo Luiz Alberto*

S09-240 **Processing Of Microencapsulated Dyes For The Visual Inspection Of Fibre Reinforced Plastics**
*Kerschbaum Martin**

S09-297 **Structure And Properties Of Halogen-Free Flame Retardant Poly (Vinyl Alcohol)/Melamine Phosphate Composites**
*Guo Dan, Bai Shibing, Wang Qi**

S09-328 **Structure And Antibacterial Properties Of Polydimethylsiloxane And Microcrystalline Cellulose Composites**
Jankauskaitė Virginija, Lisauskaitė Aistė, Prosyčevas Igoris, Vitkauskienė Astra*

S09-336 **Tensile Properties Of Ground Colemanite Filled Polyamide 6.6 Composite**
Mızrak Semih, Şahin Şenol, Şahin Tülin*

S09-345
Effect Of Talc On The Hoop Stress Of Polypropylene Blok Copolymer Composite Pipes
Findik Erkut, Şahın Şenol*

S09-352
Tensile Properties Of Calcium Carbonate Filled Polypropylene Block Copolymer Composite Pipes
*Altay Anıl, Akten Hande, Şahin Şenol**

S09-356
Investigations On The Thermoplastic Fiber Spraying Process And The Variothermal Consolidation Of 3D Preforms
*Hopmann Christian**

S09-36
Quantifying Hierarchical Mixture Quality In Polymer Composite Materials: Structure And Inhomogeneity In Multiple Scales
Nakayama Yasuya, Kajiwara Toshihisa*

S09-392
Processing Of Recycled Expanded Polystyrene And Waste Newsprint Fibers Composites
*Borsoi Cleide, Cavinato Camily, Zattera Ademir Jose, Scienza Lisete Cristine**

S09-394
High Renewable Content Sandwich Structures Based On Flax-Basalt Hybrids And Bio-based Epoxy Polymers
*Colomina Sandra, Boronat Teodomiro, Fenollar Octavio, Sánchez-Nacher Lourdes, Balart Rafael**

S09-44
Effects Of Screw Speed On The Properties Of Plasticized PLA/POSS Composites
Kodal Mehmet, Şirin Hümeyra, Özkoç Güralp*

S09-464
Evaluation Of Long-Term Performance Of Glass-Fiber Reinforced Engineering Plastics For Hot Water Supply
Yamamoto Hiroyuki, Yamada Kazushi, Nishimura Hiroyuki*

S09-5
Mechanical, Dielectric, And Electromechanical Properties Of SEBS/CB And SEBS/SWCNT Nanocomposites
Koo Chong Min, Hong Soon Man*

S09-507
Mechanical Fatigue Properties Of Hybrid Polypropylene Composites With Coconut Fiber And Talc
Es Marcela Caroline, Bettini Silvia Helena Prado , Sousa Jose Alexandrino*

S09-508
Processing Of Post-Consumer HDPE Reinforced With Wood Flour: Effect Of Functionalization Methodology
Catto Andre Luis, Montagna Larissa Stieven, Rossini Katiandry, Santana Ruth Marlene Campomanes*

S09-533
Effect Of The Injection Processing On The Mechanical Properties Of The Nanocoposites Polyamide 6/Glass Fiber/Montmorillonite – (PA6/GF/MMT)
*Damiani Renato Adriano, Fiori Jr. Jair, Silvano Josiane da Rocha, Neto Almir Barros da Silva Santos, Araújo Pedro Henrique Hermes de, Peterson Michael, Fiori Márcio Antônio**

S09-536
Solid State Rheology Of Polymer Films And Layers: Influence Of The Thickness On Mechanical Properties Of A PU-Adhesive Between Metallic Substrate
Schawe Jürgen E.K., Possart Wulff, Krogh Ludovic*

S09-540
Preparation Of Polyaniline/Sodium Alanate Hybrid Using A Spray-Drying Process
Moreira Bruna Rodrigues, Passador Fabio Roberto, Pessan Luiz Antonio*

S09-589
Development And Mechanical Characterization Of A Composite Of Polypropylene (PP) With Grinding Sludge As Fiber
Rodrigues Diego Abich, Oliveira Alex Sandro Matos de, Specht Ricardo Frazão, Campomanes Ruth Marlene*

S09-674
Optimization Of Condition For Simulant Of Highly-Filled Energetic Materials
*Choi Jong Han, Yoo Ji Soo, Lee Sangmook, Han Sang Keun, Kim Hyoun Soo, Lee Keun Deuk, Shim Jung Seob, Lee Jae Wook**

S09-712
Polymeric Biocomposites Of Poly (Butylene Adipate-Co-Terephthalate) Reinforced With Munguba Natural Fibers
*Pinheiro Ivanei Ferreira**

S09-728
Properies Of Biodegradable TPU/Waste Chicken Feathers Composites And Their Investigation Of Potential Use As Tissue Engineering Scaffold
Ozkoc Guralp, Gokce Ozge, Kasap Murat*

S09-761
Preparation And Characterization Of Composites Based On Polyester And Starch Matrix With Vermiculite
Leite Marcia Christina Amorim Moreira, Oliveira marcia Gomes, Oliveira Marcelo Ferreira Leão, China Aline Leonardo*

S09-803
The Filler Shape Dependent Mechanical Properties Of Wood Polymer Composites With Polyethylene And Poly(Vinyl Chloride) Matrix
Tomaszewska Jolanta, Sterzynski Tomasz, Krolikowski Krzysztof, Zuk Tomasz*

S09-842
Polyamide 6/Nano-Silicon Dioxide Nanocompósitos
Ambrósio José Donato, Queiróz Breno Dutra*

General Symposia:

S01 - Mixing and Compounding

S02 - Films and Fibers

S03 - Processing and Forming (Combined)*

S04 - Injection Molding and Molds

S05 - Rheology and Rheometry

S06 - Polymer Nanostructures and Nanocomposites

S07 - Natural Based and Biodegradable Polymers

S08 - Polymer Foams

S09 - Polymer Composites

S11 - Elastomers and Thermoplastic Elastomers

S12 - Modeling and Simulation

S13 - Polymer Blends

S14 - Reactive Processing

Special Symposia:

S15 - Plastic Solutions for Renewable Energy Technologies

S16 - Plastic Solutions for E-mobility

S17 - Plastic Solutions for Construction and Housing

S18 - Additive Manufacturing for Plastic Components

S19 - Manufacturing of Load-Carrying Hybrid Polymer Structures

S20 - Microtribology and Surface Analysis

S21 - DRG: Fundamental and Applied Rheology

S22 - Thermo-Mechanically Graded Materials

** The two symposia "Extrusion, joining, and coating" as well as "Blow molding, Thermoforming, and Rotomolding" have been combined.*

S09 - Polymer Composites

- Keynotes
- Oral Presentations
- Poster

S09 - Polymer Composites

Oral Presentations:

S09-3: *C. Tissandier, Y. Zhang, B. Ringuette, D. Rodrigue*
Effect of water absorption on long term properties of wood plastic composites

S09-72: *Baird Donald, Meyer Kevin J., Hofmann John T.*
Predicting the Orientation of Long Semi-flexible Fibers in the Filling of Basic Injection Molding Test Geometries

S09-92: *O. Skrabala, C. Bonten*
Enhanced Thermal Conductivity in Plate-Shaped Polymer Parts

S09-166: *B. Parveeen, P. Caton-Rose, F. Costa, X. Jin, P. Hine*
Study Of Injection Moulded Long Glass Fibre-Reinforced Polypropylene And The Affect Processing Parameters Have On The Fibre Length

S09-167: *Cordeiro Rafael, Simão Renata, Viana Hamilton, Rosa Derval*
PLA-PHB composites of lignocellulosic fibers treated with plasma

S09-176: *M. Bader, D. Schmiederer, I. Maier, C. Tuechert*
The influence of part geometry and sample preparation on the thermal conductivity of composites

S09-180: *T. Huppmann, S. Yatsenko, S. Leonhardt, E. Krampe, I. Radovanovic, M. Bastian, E. Wintermantel*
Antimicrobial Polymers – The antibacterial activity of photoactivated nano titanium dioxide polymer composites

S09-203: *J. Krückel, Z. Starý, D.W. Schubert*
Changes in the conductive structure of polymethylmethacrylate carbon black composites induced by oscillatory shear

S09-209: *Z. Starý, C. Weck, J. Krückel, D.W. Schubert*
Rheology and electrical properties of carbon fibre composites with defined filler geometry

S09-239: *Ch. Hopmann, J. Marder, K. Kuesters, K. Fischer*
Effect of cyclical loading on the macroscopic failure behaviour of fibre reinforced plastics

S09-242: *S. Epple, C. Bonten*
Production of Continuous Fiber Thermoplastic Composites by in-situ Pultrusion

S09-270: *E. L. Burton, L. Mulvaney-Johnson, D. Rhodes, P. Hewlett, B. Hamilton, P. D. Coates*
Accelerated weathering of natural and carbon black filled PA66 through combined exposure to UV, tensile stress and acidic medium

S09-313: *N.G. Karsli, C. Ozkan, A. Aytac, V. Deniz*
Evaluating the effect of sizing agent types on the properties of carbon fiber/polyamide 6.6 composites

S09-315: *R. Meier, C. Kirdar, N. Rudolph, S. Zaremba, K. Drechsler*
Investigation of the shear thinning behavior of epoxy resins for utilization in vibration assisted liquid composite molding processes

S09-317: *S. Scholl, H. Schürmann, C. Schmidt*
A cost-efficient process for the production of highly stressable, continuous fibre reinforced profiles with thermoplastic matrix

S09-334: *Ş. Şahin*
The Effect Of Particle Size To Short Term Hydrostatic Internal Pressure Performance Of Calcium Carbonate Filled Polypropylene Block Copolymer Composite Pipes

S09-350: *P. Rosenberg, R. Chaudhari, M. Karcher, F. Henning, P. Elsner*
Investigating the effect of different process parameters on the laminate properties manufactured by high-pressure RTM process variants

S09-370: *H. Ito, K.Tei, T.Takayama, Y.Takahashi, H.Sano, Y.Fujita*
Novel Polymer-based Composites using Phase Separation Structure of Polymer Blends

S09-390: *H. Takagi, K. Ohkita*
Static and impact properties of injection-molded polybutylene succinate/bamboo fiber composites

S09-401: *N. Stribeck, K. Schneider, A. Zeinolebadi, Xuke Li, Z. Vuluga, S.V. Roth*
Nanostructure gradients in injection-molded PP/MMT composites studied by microbeam SAXS

S09-402: *A. Roch, T. Huber, F. Henning, P. Elsner*
LFT foam - Lightweight potential for semi-structural components through the use of long-glass-fiber-reinforced thermoplastic foams

S09-408: *A. Menrath, F. Henning, T. Huber, A. Roch, C. Riess*
Foam-injected sandwich panels with continuous-reinforced facing

S09-507: *M. C. Antunes, S. H. P. Bettini, J. A. Sousa*
Mechanical fatigue properties of hybrid polypropylene composites with coconut fiber and talc

S09-556: *Y. Tomita, T. Tanaka, Y. Araoa, T. Umemura, S. Nakamura*
Synergistic effect of flame retardant additives and wood fillers on fire retardancy of polypropylene

S09-583: *Tatiara G. Almeida, Lindembergue P. Costa Jr, José A. M. Agnelli, Renate M. R. Wellen, Eduardo L. Canedo, Laura H. Carvalho*
PHB/Bentonite Composites. Part II: Effect of Thermal Aging and Processing Conditions

S09-593: *Michael Thomas Müller, Beate Krause, Petra Pötschke*
Additive assisted MWCNT incorporation into LLDPE by melt mixing

S09-612: *K. Rinawa, R. Sonnier, J.-M. Lopez Cuesta, S. N. Maiti*
Synergistic effect of boron containing substances on flame retardancy and thermal stability of clay containing intumescent polyamide12 nanoclay composites

S09-617: *R. Gloeckner , S. Moennich*
Robust Model based Algorithm for Fibre Distribution Characterization in Microcomputer Tomography Images

S09-691: *A. Yanev, W. Schijve, C. Martin, D. Brands*
Further weight reduction of applications in long glass reinforced polymers

S09-695: *Schwägele Sebastian, Zeiler Rico, Travain Daniel Rocha, Altstädt Volker*
Effects of defects evaluation on carbon fibre reinforced plastics manufactured by resin transfer moulding

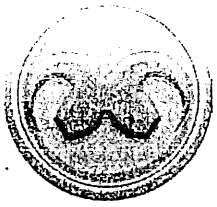
S09-732: *P. Caton-Rose, B.Parveeen, F.Costa, X.Jin, P. Hine*
Fibre Orientation Predictions in Short Glass Fibre Composite Injection Moulding

S09-733: *A. Fathi, V. Altstädt*
Balsa and Polymer Foam Core Sandwich Structures: The Influence of Through-Thickness Contour Finishing Options

S09-790: *C. Fiebig, M. Koch*
A Novel Approach to the Design of Composite Components

S09-814: *R. Zeiler, U. Khalid, C. Kuttner, M. Kothmann, D.J. Dijkstra, A. Fery, V. Altstädt*
LCM-processing and characterization of CNT modified FRC

S09-937: *Mucha H., Deckmann H.*
Composite material analysis by dynamic mechanic thermal analysis



The Polymer Processing Society

The Polymer Processing Society (PPS) was founded in March 1985 at the University of Akron, Ohio, USA. The intent was to provide a mechanism and format for interaction and presentation of research results in the international polymer processing community. The goals of PPS are to foster scientific understanding and technical innovation in polymer processing by providing a discussion forum for the worldwide community of engineers and scientists in the field. The thematic range encompasses all formulations, conversion and shaping operations applied to polymeric systems in the transformation from their monomeric forms to commercial products.

Membership for the PPS is open to all researchers in the field, and to all persons who feel the activities of the society advance their professional development.

PPS website : www.tpps.org

Founding Meeting	Akron, OH, USA, 1985
2nd	Montreal, Canada, 1986
3rd	Stuttgart, Germany, 1987
4th	Orlando, FL, USA, 1988
5th	Kyoto, Japan, 1989
6th	Nice, France, 1990
7th	Hamilton, Canada, 1991
8th	New Delhi, India, 1992
9th	Manchester, UK, 1993
10th	Akron, OH, USA, 1994
11th	Seoul, Korea, 1995
12th	Sorrento, Italy, May 27-31, 1996
13th	New York City, NY, USA, 1997
14th	Yokohama, Japan, 1998
15th	's-Hertogenbosch, The Netherlands, 1999
16th	Shanghai, China, 2000
17th	Montreal, Canada, 2001
18th	Guimaraes, Portugal, 2002
19th	Melbourne, Australia, 2003
20th	Akron, OH, USA, 2004
21st	Leipzig, Germany, 2005
22nd	Yamagata, Japan, 2006
23rd	Salvador, Brazil, 2007
24th	Salerno Italy, 2008
25th	Goa, India, 2009
26th	Banff, Canada, 2010
27th	Marrakesh, Morocco, 2011
28th	Bangkok, Thailand, 2012
29th	Nuremberg, Germany, 2013

PPS Executive Officers 2011 – 2013

President
Ica Manas-Zloczower (Cleveland, OH, USA)

Past President
Takeshi Kikutani (Tokyo, Japan)

President-Elect
Giuseppe Titomanlio (Salerno, Italy)

Secretary
Evan Mitsoulis (Athens, Greece)

Treasurer
M. Cengiz Altan (Norman, OK, USA)

Member-at-Large
Sati Bhattacharya (Melbourne, Australia)
Mosto Bousmina (Rabat, Morocco)

IPP-Chief Editor
Andrew Hrymak (London, ON, Canada)

PPP-Chief Editor
Musa Kamal (Montreal, PQ, Canada)

International Representatives 2011 – 2013 (listed alphabetically)

Volker Altstaedt (Germany)
Phil Coates (UK)
Jose Covas (Portugal)
Anup K. Ghosh (India)
Elias Hage (Brazil)
Laszlo Halasz (Hungary)
Jean-Marc Haudin (France)
Clemens Holzer (Austria)
Ibnelwaleed Ali Hussein (Saudi Arabia)
Toshitaka Kanai (Japan)
Sam Kenig (Israel)
Jin Kon Kim (Korea)
Kiyohito Koyama (Japan)
Shih-Jung Liu (Taiwan)
Y. Menceloglu (Turkey)
Paula Moldanears (Belgium)
Hossein Nazockdast (Iran)
Luiz Antonio Pessan (Brazil)
Gerrit W.M. Peters (The Netherlands)
Hans-Joachim Radusch (Germany)
Petr Saha (Czech Republic)
Krisda Suchiva (Thailand)
Uttandaraman Sundararaj (Canada)
Qi Wang (China)
Marino Xanthos (USA)
Xi Xu (China)

Plenary Speakers

Prof. Edwin L. Thomas
Massachusetts Institute of Technology, USA

Prof. Alan H. Windle
University of Cambridge, United Kingdom

Prof. Axel H. E. Mueller
University of Mainz, Germany

Prof. Georg Steinbichler
ENGEL Austria GmbH, Austria

Prof. Helmar Franz
Haitian International Holdings Ltd., China

Dr. Manfred Schmid
Inspire AG, Switzerland

Prof. Suprakas Sinha Ray
Morand Lambla Awardee 2013

Dr. Roland Hingmann (on behalf of the award winning team)
James L. White Innovation Awardee 2013

Symposia Organizers

Mixing and Compounding
Tim Osswald (USA), Ica Manas-Zloczower (USA), Natalie Rudolph (Germany)

Films and Fibers
Dirk Schubert (Germany), Narongrit Sombatsompop (Thailand), Musa Kamal (Canada)

Processing and Forming (Combined)
Michael Gehde (Germany), Michel Huneault (Canada), Jose Kenny (Italy), Hossein Nazockdast (Iran)

Injection Molding and Molds
Peter Elsner (Germany), Andrew Hrymak (Canada), Frank Henning (Germany), Shih-Jung Liu (Taiwan)

Rheology and Rheometry
Manfred Wagner (Germany), Joao Maia (USA), Masayuki Yamaguchi (Japan), Christian Clasen (Belgium)

Polymer Nanostructures and Nanocomposites
Hans-Werner Schmidt (Germany), Sati Bhattacharya (Australia), Sadhan Jana (USA), Tony McNelly (UK), Petra Pötschke (Germany)

Natural Based and Biodegradable Polymers
Christian Bonten (Germany), David Grewell (USA), Rowan Truss (Australia), Elmar Moritzer (Germany)

Polymer Foams
Christian Hopmann (Germany), Chul Park (Canada), Masahiro Ohshima (Japan), Roberto Pantani (Italy)

Polymer Composites
Alois Schlarb (Germany), Jingshen Wu (Hong-Kong), Paolo Ermanni (Switzerland), Ashok Misra (India), Andreas Spörrer (Germany)

Elastomers and Thermoplastic Elastomers
Gert Heinrich (Germany), Kinsuk Naskar (India), Tony McNelly (UK)

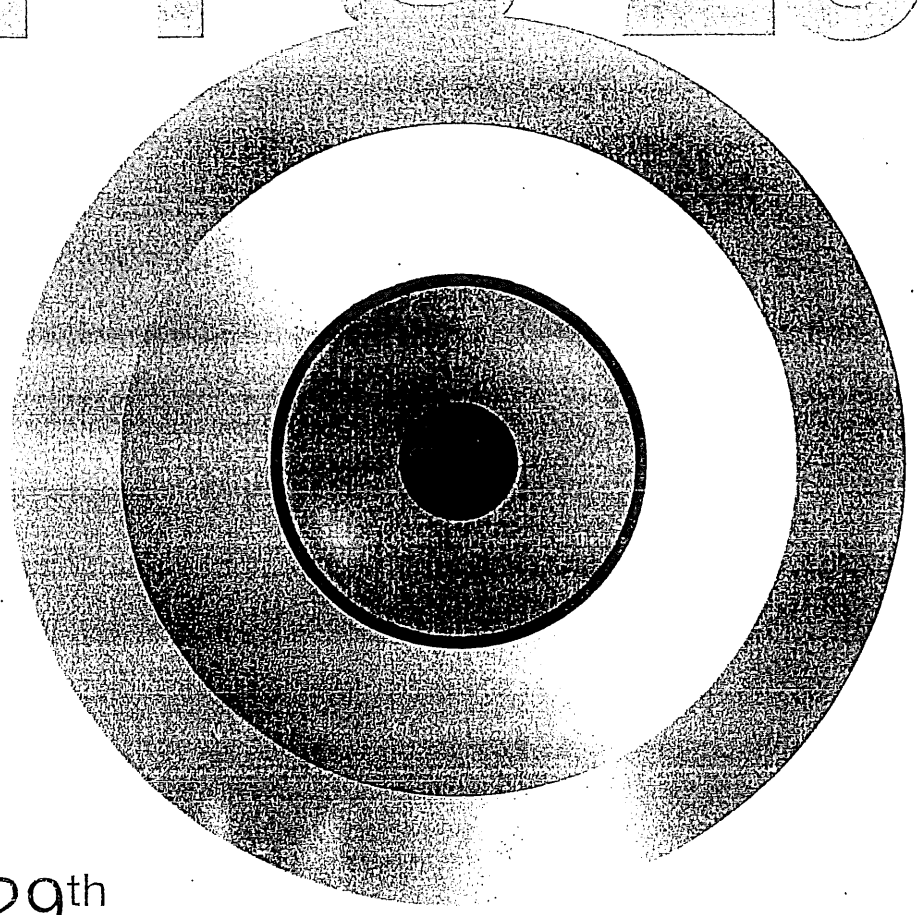
Modeling and Simulation
Johannes Wortberg (Germany), John Vlachopoulos (Canada), Rahul Gupta (Australia), Jean-Francois Agassant (France)

Polymer Blends
Hans-Joachim Radusch (Germany), Uttandaraman Sundararaj (Canada), Jozsef Karger-Kocsis (Hungary), Kiyohito Koyama (Japan)

Reactive Processing
Edmund Haberstroh (Germany), Costas Tzoganakis (Canada), Jin Kon Kim (South Korea), Phillipe Cassagnau (France)

Special Symposia
Dietmar Drummer, Werner Hufenbach, Wolfgang Weinhold, Norbert Willenbacher, Volker Altstädt (Germany)

BOOK OF ABSTRACTS



29th

International Conference of the

POLYMER PROCESSING SOCIETY

JULY 15 – 19, 2013

NUREMBERG | GERMANY

Organized by:

Neue Materialien
Bayreuth