17th Annual

SPE® TPO AUTOMOTIVE ENGINEERED POLYOLEFINS CONFERENCE®

DETROIT

TPOs Delivering Performance

OCTOBER 4–7, 2015

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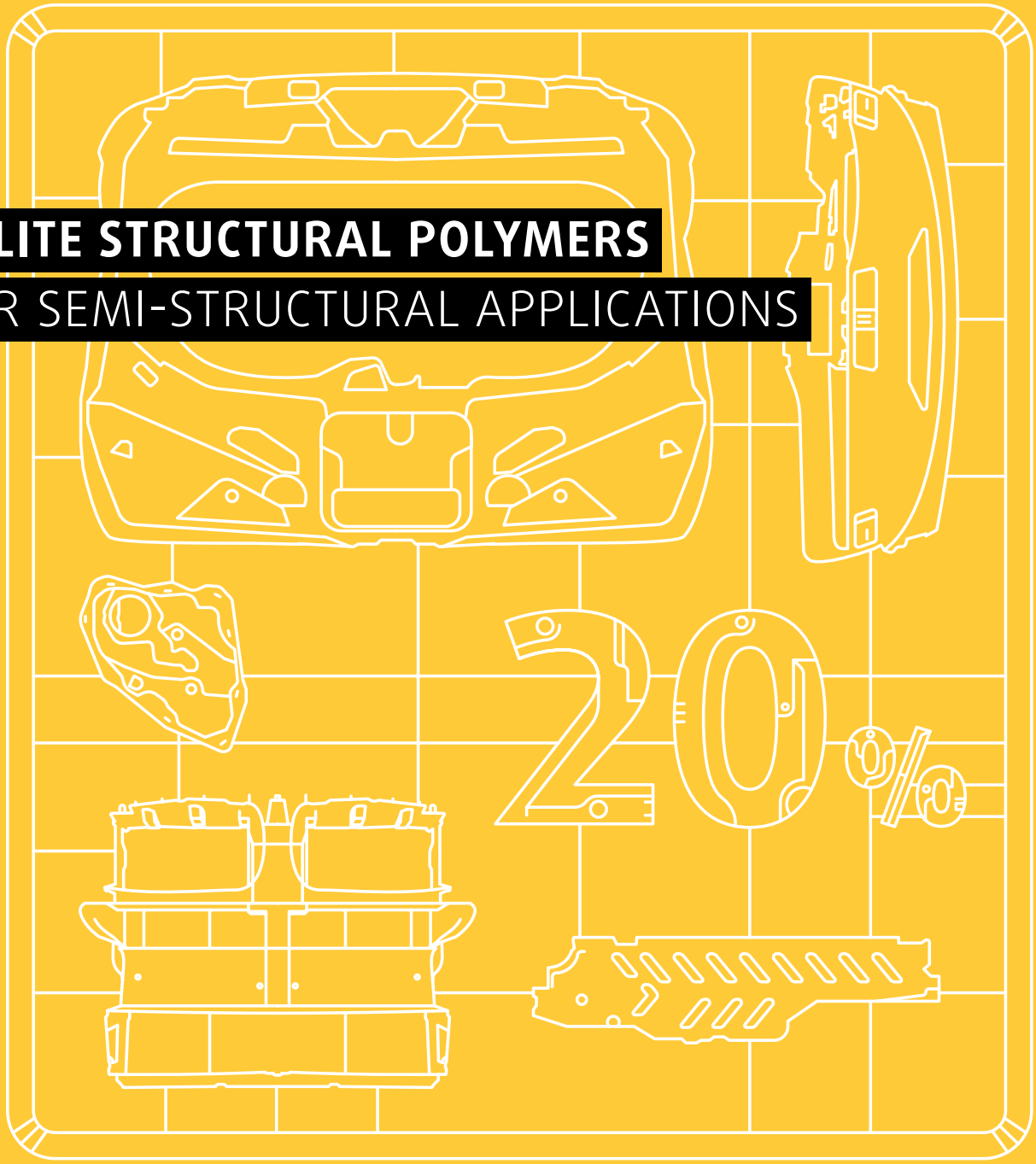
ENLITE STRUCTURAL POLYMERS
FOR SEMI-STRUCTURAL APPLICATIONS



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Lightweighting is not a trend. It is a necessity. Wherever stiffness, dimensional stability and thermal resistance are important, our **ENLITE Structural Polymers** can be used to replace existing steel and aluminum components, delivering **up to 20%** or more weight reduction. To help you explore the possibilities, our application development team stands ready to assist with design, engineering, and process expertise.

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SPE® DETROIT CONFERENCE®

TPO AUTOMOTIVE ENGINEERED POLYOLEFINS

Welcome to the 2015 SPE SPE Global TPO Conference

Thank you for attending the 17th-annual ***SPE® TPO Automotive Engineered Polyolefins Conference***, *the world's leading automotive polyolefins forum*. On behalf of our hardworking planning committee and all of SPE, we welcome you to the show and wish you a very successful event.

Whether you're here to present a paper, exhibit your company's products and/or services, or to find solutions to pressing engineering challenges, we hope you find what you're looking for at this year's show.

This is an exciting year for our conference and it looks like we'll set a lot of records:

- We expect more than 800 guests from around the world,
- We have our largest technical program ever (over 70 presentations in nine technical tracks in three parallel sessions throughout the event), and
- We have our largest exhibition ever thanks to the support of a record number of sponsors and exhibitors (76 — five of whom are supporting at the Platinum level).

Additionally, we have five exciting keynote speakers who are going to help you better understand the complex web of trends and market forces at work in our industry today and that even now are shaping our tomorrow. Not only will you leave here better informed than when you arrived — assuming you visit our sponsors and catch our technical program — but you also should leave with lots of new contacts. That's because we've built numerous networking opportunities into our 2015 program.

In addition to three receptions (Sunday, Monday, and Tuesday evenings), and daily breakfasts and lunches (Monday through Wednesday), we've also built in morning and afternoon breaks into the program so you can ask questions, meet new people, grab a beverage, and avail yourselves of the tremendous amount of collective automotive-plastics knowledge assembled at this venue.

We'd like to acknowledge all the effort our committee of volunteers have expended helping bring this year's program to you. Our team is hard at work on this conference 11 months of the year. If there's something we could do better, please don't hesitate to tell a member of our committee so we can discuss it in our postmortem. If there's something we did right, please don't hesitate to tell us that too. We're always striving to make this event better.

Sincerely,

Dr. Sassan Tarahomi
Conference Co-Chair
International Automotive Components (IAC) Group

David Okonski
Conference Co-Chair
General Motors Co.

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Advances in Automotive Polyolefins
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Rigid Polyolefin Compounds
Mike Balow, Asahi Kasei Plastics North America, Inc.
Ermanno Ruccolo, Mitsui Plastics, Inc.

Interior Soft Trim: Skins & Foams
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Surface Enhancements
Dr. Rose Ryntz, IAC Group
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Bio-Based Materials
Susan Kozora, IAC Group
Dr. Ellen Lee, Ford Motor Co.

Polyolefin Underhood Applications
Joel Myers, Hyundai America Technical Center, Inc. (HATCHI)
Jim Hemphill, Dow Elastomers

Adhesives & Coatings for TPOs
Dr. Pravin Sitaram, Haartz Corp.
Hoa Pham, Freudenberg Performance Materials

Lightweighting of Polyolefin Parts
John Haubert, FCA US LLC
Normand Miron, Washington Penn Plastic Co., Inc.

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Keynote Speakers
Bill Windscheif, Advanced Innovative Solutions
Nippani Rao, RAO Associates

OEM Participation
Neil Fuenmayor, LyondellBasell Industries
Tom Pickett, General Motors Co.
Dr. Ellen Lee, Ford Motor Co.
John Haubert, FCA US LLC
Scott Aramian, Advanced Composites Inc.

USB Drives / Online Access
Sanjay Patel, Borealis AG
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Sanjay Patel, Borealis AG
Dr. Sassan Tarahomi, IAC Group
Dr. Norm Kakarala, retired-Inteva Products LLC
Bill Windscheif, Advanced Innovative Solutions
David Okonski, General Motors Co.

Plaques / Awards / Part Competition
Nippani Rao, RAO Associates
Dr. Suresh Shah, retired-Delphi Corp.

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David Okonski, General Motors Co.

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Jill Gorter, JPI Creative
Suzanne Lee, That Color

2015 Keynote Speakers

Michael Whitens

Director Vehicle & Enterprise Sciences
Research and Innovation Center
Ford Motor Company

TPO: A Customer's Perspective

Michael Whitens, director-Vehicle & Enterprise Sciences at Ford Motor Co. will give a keynote on Monday morning entitled *TPO: A Customer's Perspective*. An automotive industry veteran with more than 29 years of experience, Whitens has spent most of his career at Ford in various body engineering disciplines. He assumed his current role last July. Before that, Whitens was engineering director responsible for leading Global Ford Body Interior Engineering. In this capacity he was responsible for global design and development of Ford interior systems — from concept to customer. A recognized industry leader in the development of automotive interiors, Whitens and his teams have won many industry accolades, including the Premier Automotive Suppliers' Contribution to Excellence (PACE) award and SPE Automotive Innovation awards, as well as been issued numerous patents for component innovation, new material development, and interior execution. Whitens also has been the recipient of several quality awards, including national recognition for U.S. Design for 6-Sigma. He currently is a member of the board of directors of the SPE Automotive Division and a member of Michigan Technological University's (MTU's) external advisory board for the Department of Electrical & Computer Engineering. He holds a Bachelor's of Science degree in Electrical Engineering from MTU and a Master's degree in Engineering Management from Wayne State University.

Dr. David E. Cole

Chairman Emeritus
Chairman, Center for Automotive Research
AutoHarvest

The Auto Future: Fast, Furious and Exciting

Dr. David Cole, chair, Auto Harvest Foundation also will give second keynote on Monday morning entitled *The Auto Future: Fast, Furious and Exciting*. Cole also is chair emeritus of the Center for Automotive Research (CAR) and the former director of the Office for the Study of Automotive Transportation (OSAT) at the University of Michigan's Transportation Research Institute as well as an engineering professor at the school. His technical and policy consulting experience includes a variety of assignments for industry, labor, and government and he has spoken to more than 1,000 different groups on automotive issues. He has been and is actively involved in the start up of nine different Ann Arbor, Mich.-based companies and is currently a director on the board of three automotive-related companies. In 2013 Cole was inducted into the Automotive Hall of Fame, the industry's highest honor and he has received numerous other honors during his career. He long has been active in industry engineering societies, including SAE International®, the Engineering Society of Detroit (ESD), and the Society of Manufacturing Engineers (SME). He holds B.S. degree in Mechanical Engineering (M.E.) and Mathematics, as well as M.S.M.E. and Ph.D. degrees from the University of Michigan as well as an honorary doctorate from Cleary University.

2015 Keynote Speakers

Brian Weider

President

Sumika Polymers North America, Inc.

Global Outlook for the Polyolefin and Automotive Businesses

On Tuesday, Brian K. Weider, president-Sumika Polymers North America, Inc., a fully owned subsidiary of Sumitomo Chemical Co., will give a keynote on the topic of *Global Outlook for the Polyolefin and Automotive Businesses*. Weider has spent more than 35 years in the plastics industry and 30 years of that in the automotive-plastics industry. He began his career in R&D at B.F. Goodrich and later joined the Santoprene TPE business of Monsanto. He also worked at GE Plastics in engineering resins and has spent the last 17 years at Sumitomo Chemicals. In his current role, he leads Sumika's North American efforts, which are solely focused on the automotive industry. Weider holds a B.S. degree in Chemical Engineering from The Ohio State University and a Master's degree in Business Administration from the Weatherhead School of Business at Case Western Reserve University.

John W. Moyer

President and COO

Asahi Kasei Plastics North America, Inc.

Oil, Shale Gas, Fuel Efficiency, Lightweighting, & Other Funny Things that Happened on the Way to the TPO Forum

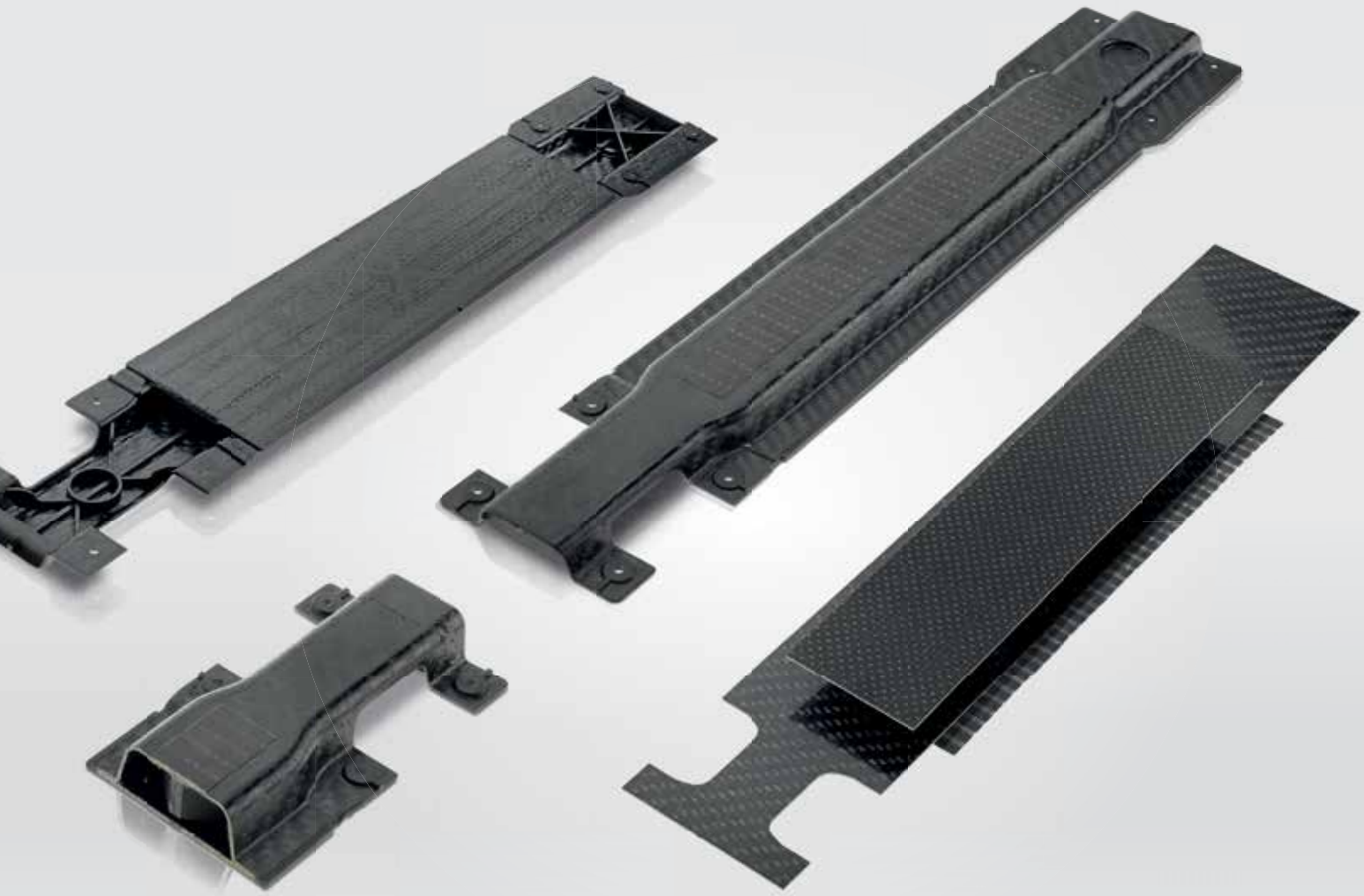
John Moyer, president & chief operating officer, Asahi Kasei Plastics North America, a subsidiary of Asahi Kasei Chemical Corp., also will present a keynote on Tuesday on the topic of *Oil, Shale Gas, Fuel Efficiency, Lightweighting, & Other Funny Things that Happened on the Way to the TPO Forum.* In his current role, Moyers leads activities for the custom compounder of polymers for the automotive, commercial truck, commercial seating, water handling, and construction markets. During his time at the helm, the company has grown substantially in the U.S. and has expanded its business base to include Mexico, Brazil, Europe, China, India, and Japan. Moyer joined Asahi Kasei Plastics in 2005 as president. Previously he worked for Dow Chemical Co. for 24 years holding various manufacturing leadership roles in the U.S., Indonesia, and Hong Kong. He also has been involved in starting up new businesses in Indonesia and China. Moyers is a member of the board of directors for the Livingston County United Way, the board of trustees for Kettering University, and the board of trustees for Cleary University. He is a past board member for the Livingston Country Red Cross, the Howell Chamber of Commerce, and the Styron Asia Ltd. joint venture between Dow Chemical Co. and Asahi Kasei Chemical Co. Moyer holds a Bachelor's degree in Chemical Engineering from the University of Cincinnati.

2015 Keynote Speakers

Matt Carroll
Engineering Group Manager
General Motors Co.

The Evolution of TPO Material Performance

Matt Carroll, P.E., engineering group manager, General Motors Co., will give a keynote on Wednesday entitled *The Evolution of TPO Material Performance.* A registered Professional Engineer in the State of Michigan, Carroll holds B.S. and M.S. degrees in Chemical Engineering from University of Detroit and Wayne State University respectively. Earlier in his career he worked at a paint plant for BASF Corp., a polymer plant owned by Huntsman, and at the Chicago-based facility for a plastics machinery manufacturer. Carroll joined General Motors in 1994 as a materials engineer and later became a vehicle system engineer on the *Buick Lucerne* program. In his current role, he is engineering group manager-Materials for the Body Exterior and Electrical group. Carroll has presented 15 conference papers and presentations, is the former newsletter editor and membership chair of the SPE Detroit Section, and is currently a member of the board of directors for the SPE Automotive Division.



Weight-saving potential in large series
Hollow composite parts with FiberForm

KraussMaffei has developed an innovative process which combines injection molding and thermoforming of organic sheets. FiberForm significantly strengthens components and allows a wide range of functions to be integrated. Other strengths:

- Fully automatic manufacturing of continuous fiber-reinforced thermoplastic injection moldings
- Short cycle times thanks to seamless integration into the injection molding process
- Ideal for manufacturing lightweight structural components for mass-production applications

Engineering Passion

KraussMaffei

Surface Enhancements

Session Co-Chairs

Dr. Rose Ryntz, IAC
Jim Keller, United Paint & Chemical

Automotive Component Lightweighting with Chemical Foaming Agents

Frank Neuber
Clariant Corporation

Lightweighting is a goal for major auto OEM's. A lighter part means a lighter automobile, thus better fuel economy. This presentation will demonstrate and explain current Lightweighting practices which use Hydrocerol chemical foaming agents.

What the Automotive Industry Can Learn from the Latest Advances in Liquid Colorant?

Jason Bateman
Color Matrix / PolyOne

The benefits of liquid colorant have long been established in non-automotive applications, but with advancements in the latest technology, liquid color offers unique benefits automotive engineers and designers must consider. This presentation will compare liquid vs. solid masterbatch technology and share some of the most compelling successes of liquid color including improving manufacturing efficiency, solving some of the most common technical challenges and creating unique special effects across a variety of polymers.

Silicones Can Enhance Surface Properties of TPEs

Greg Allen
Dow Corning Corporation

Thermoplastic elastomers (TPEs) are proven materials, broadly used by the automotive industry. Dow Corning and Multibase have developed chemistries and technologies that can enhance the surface properties, aesthetics, and scratch performances of TPEs. From adding small amounts of silicone to TPEs with siloxane masterbatch to fully compounded materials like TPSiV®, we will demonstrate how silicones in thermoplastics can help you pass OEM's strict surface requirements and create new possibilities in interior automotive design.

Next-Generation Additives for Scratch Improvement of Talc-Filled Polypropylene Auto Interior Parts

Ted Hays
Dow Corning Corporation

The automotive industry requires parts that are durable yet environmentally friendly. Dow Corning has a proven track record in delivering additives to accomplish this for talc-filled polypropylene compounds designed for car interior parts.

The next generation of Dow Corning® Siloxane Masterbatch provides excellent scratch performance at a lower dosage than previously achieved. They give the best properties including excellent scratch resistance, long term heat and UV stability, scratch durability, while limiting fogging and VOCs.

Surface Enhancements

Effect of Perceptual Properties on Scratch and Mar Visibility in Talc-filled TPOs

Marouen Hamdi*, Hung-Jue Sue
Texas A&M University

Scratch and mar can critically impact the aesthetics of TPO surfaces. A new standardized approach based on ASTM/ISO standard and a psychophysical tool was used to quantify these damages and design more visibility-resistant TPOs. It was utilized to investigate the influence of color, gloss, and texture. These factors have limited effect on scratch visibility. But green, glossy, and smooth surfaces have less mar visibility resistance. Also, slip agent additives improved scratch and mar visibility resistance.

Quantitative Modeling of Rate-dependent Polymer Scratch Behavior

Mohammad Motaher Hossain*, Hung-Jue Sue
Texas A&M University

Quantitative prediction of polymer scratch behavior via finite element method (FEM) has long been sought. However, such quantitative modeling is difficult to achieve due to the rather complex constitutive behavior of polymers and complicated contact scenarios evolved during scratching. In this study, quantitative FEM modeling has been carried out to describe the scratch behavior of model amorphous polymers. The results suggest that the scratch behavior can be quantitatively predicted via FEM modeling with reasonable success.

TPO Scratch & Mar Predictability by Simulation, Part-II Building the Surface Characteristics Database

Sassan Tarahomi, IAC

This paper is a continuation of the paper presented at the 2014 TPO Conference. FEA method is utilized to analyze surface damage by scratch and mar. Scope of this paper is to present the extensive work completed in building the database since the 2014 TPO Conference. Scan and discretization of Interior automotive surface textures and further discussion in the accuracy of simulation versus physical testing with confirmation run are discussed in this paper.

Balancing Haptics and Performance of Polyurethane Coatings for Plastics

Kurt Best
Covestro LLC

Balancing haptics and property performance of coated plastic parts has been a challenge due to the seemingly divergent qualities needed to be soft and highly chemical and mar resistant. The subjective nature of "feel" that often defines the haptic characteristic adds to the uncertainty of new product development. Within this presentation we describe the use of a Design of Experimentation to map haptic feel to performance properties of a 2K waterborne polyurethane coating.

High Performance Stabilization Systems for PP & PP-based TPO Automotive Applications

John Mara*, K. Keck, H. Kwon, J. Kim, B. Iyer, T. Schmutz
Songwon International

This presentation introduces a series of new advanced stabilizer solutions for exterior and interior PP-based TPO automotive applications. Our new stabilizer solutions also overcome the limitations of classical state-of-the-art stabilizer systems such as: additive blooming, extraction resistance, interaction with filler minerals, and interaction with acidic species. In so doing, our stabilizer solutions enable PP-based TPO compounds to respond successfully to the increasingly stringent industry standards regarding weatherability and durability.

Advances in Automotive Polyolefins

Session Co-Chairs

Neil Fuenmayor, LyondellBasell
Laura Soreide, Ford Motor Co.

Meeting the Challenge of Delivering Global PP Compound Solutions

Linda Havermans
SABIC

Today, automotive OEMs demand higher performance from PP compounds to successfully address key challenges (i.e., enhanced aesthetics, safety, weight reduction). OEMs also demand global grades that are readily available locally. Global grade design is complex and challenging because of regional differences in raw material profiles. However, globally unified PP compound performance profiles can be achieved, as this session will demonstrate, by focusing not only on material compositions, but also properties critical to success.

Innovative Polypropylene Light Weight Solutions for the Automotive Industry

Michael Tranninger
Borealis Polyolefine GmbH

Borealis lightweight PP solutions, contribute to the overall weight reduction of the vehicle, therefore helping in saving fuel and lowering the CO2 emissions. Furthermore, the aesthetics of the car are becoming more and more important. Borealis will introduce new PP material solutions overcoming the challenges in material design to provide low density, excellent mechanical properties and outstanding surface aesthetics. Furthermore an outlook on foamable automotive material solutions with excellent surface will be given.

Surface Mark in Polymer Injection Molding with Viscoelastic Fluid: Experiment and Simulation

Dr. WenHsien (Anthony) Yang*
CoreTech System (Moldex3D) Co., Ltd.

Jye Wang, Srikar Vallury
Coretech System (Moldex3d) Co., Ltd.

Laura Soreide, Li Qi, Ken Kwasnik, Jeffrey Kloberdanz, Danielle Zeng
Ford Motor Company;

Neil Fuenmayor, Mickey Sinopoli
LyondellBasell

Flow marks are critical surface defects for injection molded parts, especially for unpainted appearance applications. The flow instability due to viscoelastic behavior during mold filling is considered one of the major causes of flow marks. Moldex3D flow solver with multi viscoelastic melt flow for a wide spiral shaped part. Simulations show interesting correlation to the flow observed in the experiment.

TPO Elastomer Choice Impacting Paint Performance

Russell Barry*, Kyle Anderson, Jim Hemphill, Brian Dorvel, Olaf Henschke, Kim Walton
Dow Chemical Company

OEMs continue to pursue light weighting and increased part complexity while still striving to meet performance and aesthetic needs in TPO components. Some challenges still remain in maintaining surface aesthetics and paint adhesion in exterior bumper TPO parts during aggressive paint durability testing.

Recent findings suggest that elastomer choice (e.g. ENGAGETM XLT) can enable high impact performance, excellent compatibility and superior heat resistance while allowing TPOs to meet the demands of aggressive durability tests with primer-less painting systems.

Advances in Automotive Polyolefins

Mastering the Challenges of Globalising an Engineered Polyolefin Business

Jakub Oliverius
Borealis AG

Together with its joint venture Borouge, Borealis is actively responding to demands from the OEMs and tiers to globalize its offerings. Insights will be provided into how Borealis is overcoming the challenges of expanding from its strong European base. Topics include the establishment of compounding capacity in the main automotive clusters via differing business models; the development of an international team; and next steps in our journey as a leading supplier of polyolefins to the automotive industry.

Improving TPO Performance and Sustainability with Innovative Stabilizer Solutions

Dr. Jian-Yang Cho*, Jerry Eng, Brent Sanders, Dr. Andrea Landuzzi
Cytec Industries

TPO has become the material of choice in the automotive industry as replacements for heavier materials to make cars lighter and more fuel efficient. This trend poses additional performance requirements, such as increasing TPO weathering durability, thermal stability and specific physical properties. Resin optimization and the development of high performance stabilizers afford TPO the opportunity to support and satisfy that demand and accelerate the creation of new opportunities.

Anti-scratch Additives for Polyolefins

Adam Maltby
Croda Inc.

The use of plastics in automotive applications is becoming increasingly popular due to improved polymer technology and durability, coupled with the regulatory need to lightweight vehicles and reduce CO_2 emissions. In this presentation, Croda will discuss products developed for this challenging market that can be utilized in a range of automotive applications including interior and exterior parts and under hood components. Croda will focus on additives for mold release and anti scratch for molded parts.

Advanced Halogen-Free Flame Retardant Technology for Polyolefins

Yutaka Yonezawa
ADEKA Corporation

The use of polyolefins in automotive applications continues to grow as a means of lightweighting parts. Demand to improve flame retardancy of these polyolefin parts has increased dramatically with the spreading of hybrid and all electric vehicles. Weatherability of these flame retarded polyolefin parts is an essential property for this application. This paper describes the weather resistant performance of polypropylene with our intumescent flame retardant system.

Rigid Polyolefin Compounds

Session Co-Chairs

Mike Balow, Asahi Kasei Plastics North Americ, Inc
Ermanno Ruccolo, Mitsui Plastics, Inc.

Understanding Emissions of PP Based Resin Compositions

Dr. Laura Shereda
Asahi Kasei Plastics
North America, Inc.

Odor, fog, and VOCs have been on the radar in Europe for many years, and now automotive Tier suppliers in the rest of the world are working frantically to understand the issues. Now with specifications for VOCs, odor, and fog being included on customer prints, reliable methods and materials must be developed to consistently meet these standards. Polypropylene based compounds pose different challenges than several more traditional compounded materials. This presentation will discuss challenges with testing and development of low VOC materials.

The ABC's of VOCs

Alec Lang
Reliable Analysis

A simple yet thorough explanation of VOC industry for emissions testing. From simple odor tests to full chamber tests, the presentation will cover the basic methods of testing available today.

Effective Machining Practices for Testing Directional Properties of Short Glass Fiber Reinforced Composites

Daniel Dubiel
Asahi Kasei Plastics
North America, Inc.

Accurate material characterization for FEA has become paramount when trying to achieve significant weight savings during the design of a plastic component. In order to understand the local behavior of a material, it has become common practice to machine tensile specimens in varying orientations from an edge gated molded plaque. The focus of this study is to address common machining pitfalls and their effect on base mechanical properties of an anisotropic material.

The Effect of Co-Reinforcement on the Directional Properties of Long Glass Fiber Reinforced Polypropylene

Katie Shipley
Asahi Kasei Plastics
North America, Inc.

With the ever-present need for weight reduction and cost reduction, the use of plastics in automotive applications is increasing. Long glass fiber reinforced polypropylene has been used for structural and semi-structural rigid applications; however, the properties are anisotropic due to alignment of the glass fibers in the flow direction during molding. This study looks at the effect of various co-reinforcement materials in long glass fiber reinforced polypropylene on the directional properties of the compounds.

Ultralight TPO technology enabled by Long Polymer Fibers, Glass Bubbles and Microcellular Foam Injection Molding

Stephen Amos
3M Company

Reducing the weight of plastic parts of a vehicle has been a critical objective for the automotive industry due to increasing governmental carbon emission and mileage regulations. In this presentation, we will present the development of an ultralight (down to 0.70 composites enabled by incorporating the 3M Glass Bubbles, Long Polymer Fibers (PA or PET create an ultralight composite where the thermoplastic fibers (e.g. nylon, PET) contribute to impact and tensile/flex strength, 3M iM16K Glass Bubble

Rigid Polyolefin Compounds

to density reduction and modulus and Trexel MuCell also discuss benefits of hybrid glass fiber, polymer fiber and Glass Bubble combinations with and without foam for applications that require higher stiffness and heat distortion temperatures.

Automotive structural Parts with the Medium Length Fiber Reinforced PP Composites

P.B. Raman*,
Dr. Sambhu Bhadra
Steer Engineering Pvt. Limited, India;

V. Kannan
Reliance Industries Limited, India

Glass and Jute fibre as continuous roving have been chosen for the development of medium length fiber reinforced composite using PP as matrix. A Compounding Twin screw extruder has been designed as opposed to the pultrusion coating technique adopted for LFRTP. Mechanical & thermal properties show superiority over mineral and short glass fibre composites as expected with 10 to 20% lower density, thereby suitable for light weighting. This paper provides property comparison of short, medium and long fibre reinforcements along with possible applications for this material.

New High Performance Talc products for Automotive TPOs

Maziyar Bolourchi*,
Ed McCarthy,
Saied Kochesfahani
Imerys Talc

The Automotive demand for light-weighting and increased performance of TPO materials are ongoing and have led to many innovative technologies. The new North American ultrafine and high aspect ratio (HAR) talc products have been developed to help address these needs. Experimental data will be presented in TPO formulations showing superior reinforcement of new NA HAR talc products and the optimum stiffness/impact performance of new ultrafine talc products. Both of which are available in high-brightness grades.

Advanced Applications for Long Glass Fiber Polypropylene in Automotive Applications

Richard Tuttle*,
Kouichi Saitou
Comusa Inc

Japan Polypropylene will discuss the advantages of its Funcster line of LFGPP compounds and the unique characteristics of this material in structural and appearance applications.

Novel post-consumer recycled polypropylene with glass fiber reinforcement products for numerous automotive exterior applications

Dr. Deen Chundury*,
Cody Thompson
Wellman Plastics Recycling, USA

We present development activities of glass fiber reinforced post-consumer recycled (PCR) polypropylene products for numerous automotive exterior applications. We have evaluated both by-product PP and all PP based carpet feed-streams. We compare 100% PCR based glass fiber reinforced PP compounds to that of post-industrial and virgin-based GF/PP compounds

17TH-ANNUAL SPE DETROIT TPO AUTOMOTIVE ENGINEERED POLYOLEFINS CONFERENCE

Interior Soft Trim: Skins and Foams

Session Co-Chairs

Bob Eller, Robert Eller Associates, LLC
David Helmer, General Motors Co.

Current and Future Prospects for TPOs and TPEs in Interiors

Bob Eller
Robert Eller Associates LLC

Compound technology and fabrication methods are enlarging the properties envelope for TPOs and TPEs in interiors. This paper explores enablers, targets and paths to innovation in interiors including foams, soft touch technology, skins, body/glazing seals, and acoustics within the context of a shifting supply chain, globalization and shifting performance requirements.

Achieving Self Expression with Lightweight Innovations

Thomas Malner
Benecke / Contitech

Benecke-Kaliko will premiere a new product line-up that goes beyond TEPEO and TEPEO 2 to offer the ultimate in freedom of self-expression. New state-of-the-art product enhancements pertaining to eco optimization, ultra-lightweight, and premium surface protection will be also presented. Additionally, Benecke-Kaliko offers a comprehensive portfolio of Feature Optimized Customer Unique Solutions and will highlight new innovations added to its F.O.C.U.S. family. Benecke-Kaliko stands ready to support the industry with nearly 300 years of experience advancing soft-touch surface solutions.

Digital Printing for Flexible Interior Trim – Application in the Toyota Yaris Trend

Elizabete Pinho*,
Dr. César Águia, Tiago Maia,
TMG Automotive, Guimarães, Portugal

Dr. Rob Tol
Toyota Motor Europe

Highly customized interior trim developed by Toyota Motor Europe and TMG Automotive: The Toyota Yaris Trend Edition. This paper focuses on the advantages and challenges of using digital printing technology in automotive interiors. A comparative overview of printing processes will be made and the case study will highlight the role of Toyota's first-in-Europe model as a trend-setter. The technology selected to materialize Toyota's Design features led to "zero-tooling" and quicker time-to-market.

Formulating TPOs for Demanding Interior VOC Performance

Jue Lu*, Alberto Prieto, Charlie Yang
LyondellBasell

The global automotive industry is demanding improvements in organoleptic properties and air quality of their vehicle interiors by requiring reduction of volatile organic compounds (VOCs) emissions. OEMs have added VOC requirements on their material and part specifications. To meet these global targets, LyondellBasell has conducted extensive research on how VOCs of PP compounds are affected by various formulation, manufacturing and environmental factors. VOC requirements will be reviewed and technologies to reduce VOCs will be shared.

Interior Soft Trim: Skins and Foams

Development of Process and Material for Injection Foaming Molding

Simon Cho, Lotte Chemical Group

TPO has become the material of choice in the automotive industry as replacements for heavier materials to make cars lighter and more fuel efficient. This trend poses additional performance requirements, such as increasing TPO weathering durability, thermal stability and specific physical properties. Resin optimization and the development of high-performance thermal and ultraviolet (UV) stabilizer systems are required to afford TPO the opportunity to support and satisfy that demand and accelerate the creation of new opportunities.

Improved PP Foam Properties with Kinetic Nucleator Additives

Peter Schroeck*, R. Minton
Reedy International

Emphasis on light being used in automotive plastics. As auto makers optimize use of PP/TPO, chemical foaming agents are desirable due to low environmental impact and easy incorporation into all molding processes. Novel Kinetic Nucleators are available which achieve cells 50-100% smaller, resulting in lighter densities and greater impact strength in finished parts.

Microcellular Foaming: Enhanced Design Freedom and Surface Characteristics in Automotive Interior Parts

Levi Kisbaugh, Trexel Inc.

Designers of automotive interior trim are challenged with creating excitement at the lowest possible cost. This paper examines how MuCell microcellular foam molding has been an enabling technology in enhancing design possibilities in injection molded interior parts while reducing part weight. The paper also depicts a case study of a "molded in color" application for a highly aesthetic video screen bezel.

Discussion of Thermoplastic Concentrates/Additives and Automotive Interior Applications

Dr. Sam He, Inteva Products, LLC

Thermoplastic concentrates / additives are needed to improve properties and processing and for product's functions and performance. This paper discusses some key requirements and essential expectations for concentrations / additives and the suppliers. The discussion includes additives, processing aids, color and colorants, surface appearance quality of components, and end users' experience. The presentation covers the expectations of automotive interior customers, business trends, innovation, development cooperation, supply quality and delivery.

Pursuing High Safety Performance in Airbag Cover Applications

Shun Takahashi*,
Nobuhiro Natsuyama
Sumitomo Chemical Co., Ltd.

Increased automomobile safety awareness demands reliable airbag deployment performance . TPO is a well-known material used for airbag covers and its impact resistance plays a significant role in the deployment performance. In this study, we focused on the effect of rubber design as relates to its use in TPO formulation and successfully developed novel products which showed outstanding balance between their stiffness and impact resistance.

New Additive Innovations in PP Support the Trends in the Automotive Industry

Herrin Hood, Milliken Chemical

The automotive industry continues to increase demand for lighter weight parts to reduce emissions and increase fuel economy. Moreover, low CLTE and shrinkage control for automotive plastic is always an increasing requirement. This paper will provide examples of additives that reduce weight and dramatically improve flowability and impact in PP compounds. Also, new insights into 3-dimensional shrinkage of polypropylene can create opportunities for new nucleating technologies to address increasing demands for dimensional control.

Lightweighting of Polyolefin Parts

Session Co-Chairs

John Haubert, FAC
Normand Miron, Washington Penn Plastics Co.

Enable Lighter Designs: The Renault Espace Full TPO Liftgate

Anis Tebib,
Trinseo Automotive

In a joint project, Renault and Trinseo developed a full thermoplastic lift-gate solution, which was commercialized and implemented on the serial production of the 2015 Renault Espace. The solution involved replacing metal with plastic on a key vehicle component. The innovative aspect was the use of a single thermoplastic material with different fillers for a mono-material lift-gate. The final design achieved optimal dimensional stability which had been considered the main challenge.

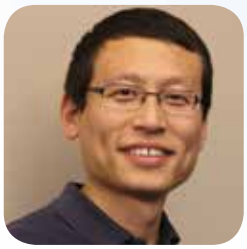
High Performance Reduced Density TPO Compounds for Weight Savings

Jason Fincher
Advanced Composites

Talc-Filled TPOs offer numerous mechanical property advantages over reactor polypropylene. However, talc utilization increases polypropylene compound density. Fuel economy has led the automotive industry to investigate reduced density TPO materials to decrease weight. This work will explore the mechanical property ramifications of lowering talc content of current materials for reduced density. Advanced TPOs will be presented that maintain performance while decreasing density. Merits of reduced density TPO will be compared to other TPO lightweighting strategies.

Carbon Fiber Reinforced Polypropylene Compound and its Application

Junjun Li
Asahi Kasei Plastics, North America



Carbon fiber reinforced plastics have shown its prominence in weight processing in many automotive structural applications. However, carbon fiber filled polyolefin system is still in its infancy. In this work we fabricated carbon fiber filled polypropylene compounds and evaluated its LTHA performance. A brief comparison of specific strength and density between glass fiber and carbon fiber compounds will be made. The results represent a potential value proposition of carbon fiber filled polypropylene in high temperature structural applications.

Weight Reduction Technologies for Long Glass Reinforced Polypropylene

David Brands*,
Angel Yanev
SABIC

Semi-structural plastic parts, such as front-end module carriers, are typically designed using complex geometrical shapes and ribbing to help achieve weight-out. For less structural parts (i.e., IP carriers, door modules), weight-out is usually achieved by reducing wall thickness or mass density (by using foamed parts). This study compares different weight reduction technologies – chemical foaming, physical foaming and thin wall compact injection molding – applied to a LGFPP composite resin to help define optimal performance.

Lightweighting of Polyolefin Parts

New Developments in Talc and Cellulose Fiber Reinforced Polypropylene Compounds for Automotive Interior Weight Savings

Vive Apte
Asahi Kasei Plastics, North America

Asahi Kasei Plastics has recently developed several new PP compounds. These new compounds are based on Cellulose Fiber and/or also include high flow, strength and stiffness talc-filled PP grades. These provide equivalent performance at reduced weight. The use of these new PP compounds that provide equivalent level of stiffness yet lower carbon foot print will be discussed in the context of material replacement to achieve a value/performance proposition.

Automotive structural Parts with the Medium Length Fiber Reinforced PP Composites

P.B. Raman* &
Dr. Sambhu Bhadra
Steer Engineering Pvt. Limited, India

V. Kannan
Reliance Industries Limited, India

Development of proprietary wave elements in the twin screw extruder improves mixing of continuously fed jute twines or glass rovings without attrition paves the way for making pellets 6-8 mm length. These longer pellets show promise of improved modulus and heat resistance compared to conventional pellets 4 mm length with chopped fibers. Niche markets are identified where these materials can substitute conventional grades and reinforced PA (Polyamide) for economy and weight reduction in molded parts.

Achieving Weight Reduction and a Balance of Properties with PP Compounds in Both Interior and Exterior Applications

Bhuwneesh Kumar,
Linda Havermans*
SABIC

The automotive industry is challenged to remove weight to improve fuel efficiency and reduce emissions. Smart design, like ribbing, can get weight-out in semi-structural plastic parts, but not in less structural parts produced from PP compounds. For some interior parts, a challenge is to achieve low temperature impact resistance while maintaining (or even increasing) stiffness without processing penalties. This paper provides innovative approaches to save weight, with minimal tradeoffs, and an excellent property balance.

Adhesives and Coatings for TPO

Session Co-Chairs

Hoa Pham, Freudenberg Performance Materials
Dr. Pravin Sitaram, Haartz Corporation

Overcoming The Challenges Posed By Consumer Products Used In Automotive Interiors

Dr. Pravin Sitaram*, Kristine Togneri
The Haartz Corporation

As consumers try to resist germs, bugs, the sun and more, they are transferring these chemicals to the surface of their vehicle's interior. The molded soft trim materials in automotive interiors have a new challenge to resist these chemical attacks. To combat the challenge, extensive R&D efforts at Haartz have resulted in new TPO formulations and lacquers that achieve greater chemical resistance while maintaining a balance between performance, processing, haptics and environmental responsibility.

Emerging Technologies In Coatings - A Convergent Thinking

Dr. Jamil Baghdachi
Eastern Michigan University

Automotive coatings can benefit from Emerging Technology and Convergent Thinking approaches. This new millennium will see rapid advances in materials often referred to as Smart Materials/Coating. These smart coatings include biologically active, stimuli responsive, conductive, antimicrobial, antifouling, self-healing, sensory, super hydrophobic, bio-decontamination, detection, color shifting and Nano-engineered coatings. In this presentation, we will discuss the technology of such materials, present pathways and examples of such products and highlight current global research and development trends.

EVO Coatings

Martin van den Berg
Stahl

Days of a "nice new car perfume" are over. Carbohydrate emissions are no longer tolerated because of legislation, OEM specific car interior guidelines (based on toxicology) and consumer. Stahl, a leading manufacturer of coatings for car interior trim applications, is launching a new series of coating products that not just comply with the most stringent OEM requirements of emission, aesthetic and technical performance, but also takes it one step beyond by introducing coatings with an ongoing increasing content of renewable raw materials.

Reactive Film Adhesive – An Intriguing Potential Solution for Interior Automotive Trim Lamination

Dr. Rituparna (Ritu) Paul
H.B. Fuller

Reactive film adhesive is ideal for interior automotive trim applications. Films are resistant to heat, moisture, and chemicals, and their low activation heat protects substrates and materials like textiles and leather. Film can be stored unrefrigerated, is less messy than liquids or hot melts, and allows initial adhesive application to be moved from Tier 1 suppliers to Tier 2 suppliers. This presentation addresses their chemistry and use in the automotive field and provides supporting data.

Adhesives and Coatings for TPO

A New Option for Automotive Trim Assembly

Dr. Marlen Valverde*, Kellen O'Brien
H.B. Fuller

Water-based adhesives require mixing, take time to set, and require specialized drying equipment. Adhesion to non-polar materials requires pre-treatment. Ordinary reactive hot melts (RHM) require separate formulations for polar and non-polar substrates and pre-treatment of non-polar substrates. A new sprayable RHM with reduced VOCs and free isocyanate monomer can adhere to polar and non-polar substrates without pre-treatment. This presentation addresses its chemistry and applicability to the automotive field along with supporting data.

Value Added TPO Products for the Global Automotive Platforms

Dr. Johnny Zhang*
Shanghai PRET Composites, China;

Dr. Deen Chundury
Wellman Plastics Recycling

Elastomer modified PP compounds provide ductility for seamless airbag parts but often results in unacceptable tiger stripping (surface defects). Novel TPOs provide a combination of superior impact and exceptional flow to eliminate the tiger stripes. Innovative TPOs that meet stringent interior part performance requirements were introduced to support VW, Ford and other global OEMs and their Tiers. Eco-friendly and valued-added PP compound development with superior heat aging for the door module application will be reviewed.

Process Enabling Technologies

Session Co-Chairs

Kurt Anthony, Washington Penn Plastic Co., Inc.
Dr. Suresh Shah, Delphi (Retired)

Enabling Light-Weight Aesthetic Parts with Mucell-Synergistic Material Technology

Barry Watson*
Trexel Inc.

Sameer Mehta
Asahi Kasei Plastics, North America

Automotive engineers and designers have been challenged for years to develop lighter interior and exterior plastic parts without compromising functionality. Mucell gas assist technology helps deliver light-weighting goals while providing added benefits of better dimensional stability and lower cycle times. However, the challenge of creating aesthetically acceptable surface has limited use of Mucell technology. This paper presents Mucell-synergistic material innovation solving the surface issue enabling acceptable aesthetics allowing engineers and designers further light-weight design leverage.

The Study of Dynamic Behavior of Core-material Penetration in Multi-Cavity Co-Injection Molding

Yang, Chao-Tsai (CT) Huang, Hsien-Sen Chiu1, and Jimmy C. Chien
CoreTech System (Moldex3D) Co., Ltd., Hsinchu, Taiwan;

Anthony Wen-Hsien Yang
Moldex3D North America, Inc, USA;

Srikar Vallury*
Core Tech System Co., Ltd.

The core penetration and flow balance control problems of co-injection molding are very difficult to manage, especially in a multi-cavity setting. In this study, the dynamic behavior of core-material penetration in multi-cavity co-injection molding is discussed in depth using CAE simulations. The results show that the length of core-material penetration in such a system is strongly dependent on material, geometrical design, and process conditions. The results also show a good agreement between simulation and experiments.

Flow-Line Defect Analysis of a Thermoplastic Polyolefin

David Okonski*, Alicyn Rhoades, Nathan Greene, Ryan Gillon
General Motors Research & Development Center

A compounded TPO is really nothing more than an immiscible blend of polypropylene, rubber, and filler. We all hope these ingredients are robustly dispersed so that the resulting material behaves consistently, but each of these raw ingredients has a different viscosity and a different pseudo-plastic behavior that makes the homogeneity of the whole compound susceptible to shear. As such, it becomes possible to locally separate individual ingredients from the continuum resulting in flow

Grain Development & Grain Repair on a 7, XXX-series Aluminum

David Okonski*, Gavin Benedict, Lisa Benedict, David Duff
GM Research & Development Center

GM engineers have been developing an injection mold tooling strategy over the last five years that uses aluminum alloys to meet low, medium, and high volume TPO part requirements. Implementation has required the engineers to overcome both ingrained cultural prejudices and technical roadblocks such as the ability to apply a texture to a part's show surface. This paper reviews the work being accomplished in grain development and grain repair on a 7,XXX-series aluminum, Alcoa's QC-10.

Process Enabling Technologies

Technology Advances in Hot Runner Systems for TPO Applications

Mitch Gordon*,
Bill Rousseau
Synventive Molding Solutions

TPO is commonly used in many cosmetically demanding applications. Recent developments in hot runner valve pin control technologies are allowing molders to obtain cosmetics not previously possible. These enabling technologies do add to the upfront tooling costs putting molders in a difficult position of guessing when the additional investment is necessary. A modular approach to implementing these technologies can greatly reduce the financial risk to the molder by allowing them to evaluate the needs of the tool prior to making the investment.

Latest IMM Technologies for Efficient Molding

Jochen Mitzler
KraussMaffei Technologies GmbH

- Production efficiency – 1160 additional production hours with automatic mold change
- High gloss surface technologies
- Increased reinforcement through back molding of fiber composite materials

Improving Surface Finish and Part Performance in Injection Molded Parts

John Blundy
HRS Hot Runner System NA, Inc.

The process of sequential molding has made it possible to produce single cavity multi-gated injection molded components without cosmetic defects such as hesitation lines, yet current technology still can produce undesirable results. HRS has developed a servo-driven valve gated hot runner system which has proven to not only improve this condition for class "A" surface finish components, but to light weight them as well. The technology and applications will be presented.

Additive Manufacturing Applications with 3D printing

Bryant Goudelock
Fisher/Unitech

This presentation will explore the uses and applications in industry today for the exciting and innovative technology of 3D Printing. We will discuss applications such as tooling, Jigs, fixtures, gages, prototype tools, using thermoplastics instead of aluminum and/or ren board for molds, thermoforming, vacuum forming and even sheet metal stamping.

Industries such as automotive, tooling, medical and others will be discussed and examples shared.

Sustainability & Bio-Based Materials

Session Co-Chairs

Susan Kozora, IAC
Dr. Ellen Lee, Ford Motor Company

From Soft to Strong Sustainable Elastomers: The Role of Graphene Nanoplatelets in Thermoplastic Elastomers

John Rizzo*, Alper Kiziltas, Deborah Mielewski
Ford Motor Company

Graphene has become a prevalent constituent in elastomer nanocomposites thanks to its superior stiffness and strength, as well as its potential to enhance multifunctional properties. In this study, thermoplastic elastomers based on recycled polypropylene (RPP) and renewable guayule latex were prepared and graphene nanoplatelets (GnP) were added to enhance properties. The coupling agent used in this study was polypropylene-graft-maleic anhydride (PP-g-MA). GnP reinforced composites could be used in the next-generation of automotive thermoplastic elastomer products.

Recovering Polypropylene from Medical Insulin Syringes

Scott Melton
ACI Plastics

ACI Plastics has a closed loop program with the largest medical device maker in North America. ACI takes post industrial insulin syringe scrap comprised of many different resins and recovers the PP and HIPS. The process involves specific grinding methods, magnetic separation, density separation and pelletizing. The finished product is used by the scrap generator in non-medical applications.

Characteristics of a New PET/Polyolefin Compatibilizer and Effects of Improving the Physical Properties of Polymer Alloys

Michio Morita*, Yukiko Tamura, Kentaro Kanae
JSR Corporation

For the purpose of recycling of plastics from automobile shredder residue it is necessary to improve compatibility between polyethylene terephthalate (PET) and polyolefin. We investigated the features of new PET/polyolefin compatibilizers, which provide excellent improvement of mechanical properties of PET/polyolefin blends. These advanced physical properties result from improvement of compatibility between PET and polyolefin. These compatibilizers can contribute to the effective utilization of PET/polyolefin mixed resources.

Commercial Prospects for Bio-Based Chemicals

Dr. Patrick B. Smith
Michigan Molecular Institute

The chemical industry has been based almost exclusively on fossil feedstocks for nearly a century but bio-based feedstocks are beginning to make inroads. Fossil feedstocks are projected to continue to be abundant and inexpensive for the foreseeable future. Therefore, the commercialization of bio-based materials will need to proceed with a strategic business discipline within this context. This presentation will survey the major commercial bio-based projects and identify trends within the industry.

Sustainability & Bio-Based Materials

Thermoplastic Foams with Lignin Green Contents

Dr. Hongbo Li
National Research Council of Canada (NRC)

Thermoplastic foams such as polypropylene (PP) foams are widely used in automotive for applications such as bumpers and headliners. They are also foreseen as potential substitutes for polyurethane foams currently used for seatings. Lignin, a by-product of the pulp and paper and bioethanol industries, is the second most abundant natural polymer after cellulose. In this work, lignin was blended with various thermoplastics, including PP, by twin-screw extrusion compounding. Low density foams were prepared by solid state foaming. The properties of these partially bio-sourced foams are compared with those of conventional foams.

Automotive Biocomposites Based on Cellulose Filament Technology

Gurminder Minhas
Performance BioFilaments

The presentation will summarize recent activities of Performance BioFilaments toward the commercial development of cellulose filaments. Cellulose filaments are produced using a proprietary process that utilizes a mechanical treatment on sustainably produced wood pulps to generate nano fibrillated cellulose. Due to their high aspect ratio, cellulose filaments show improved performance in a wide variety of composites suitable for use in automotive applications. Composites using cellulose filaments can also provide light-weighting opportunities.

Bio-PlusTM Nanocellulose Composites for Automotive Applications

Dr. Kim Nelson
American Process Inc.

Cellulose nanomaterials including cellulose nanocrystals (CNC) and cellulose nanofibrils (CNF), are extremely strong, biobased, renewable and non-toxic. Cellulose nanomaterials can provide reinforcement and improved barrier properties in polymer composites, hydrogels and aerogels with materials such as polypropylene, polyester, nylon, and polylactide for automotive applications. Major challenges are cost and compatibility with hydrophobic polymers. The presentation will describe a new process that meets these challenges.

Evaluation of Ekstend™ Bio-Filled Polypropylene

Ehsan S. Monfared, Leonardo C. Simon*
University of Waterloo

Sylvain Brasseur
SPB Biomaterials

Deborah F. Mielewski
Ford Motor Company

A new type of biofiller based on oat hull fibers (called EkstendTM) was evaluated for mechanical properties in combination with polypropylene and additives. The amount of natural fiber, the nature of the polypropylene, the amount of coupling agent and impact modifier can affect the properties. The use of oat hull fibers is beneficial to reducing molding cycle-time (when compared to polypropylene) and decrease the molding energy (by reducing barrel temperature and reducing mold cooling).

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Polyolefin Underhood Applications

Session Co-Chairs

Jim Hemphill, DOW Elastomers
Joel Myers, Hyundai America (HATCI)

Drivers for Polyolefins Growth in Underhood Applications

David Reed
General Motors - Retired,
Automotive Plastics Consultant

There are several drivers that favor increased demand for polyolefins to meet automotive fuel economy and part cost targets. For under-the-hood applications, this will likely result in more and larger under hood and under body aero-panels for energy savings, as well as more under hood appearance panels for styling. Simultaneously, under hood temperatures are going up which will challenge the use of TPO alternatives, but may also offer opportunities with new reinforced PP technologies.

Compatibilzation Improvement of Nylon 6/Polypropylene Blends

Ying Shi
A. Schulman Inc.

This paper is a case study of different types of compatibilizers for nylon 6 and polypropylene blends. The compatibilizers that were investigated in this study were maleic anhydride grafted copolymers. The compatibility was evaluated by thermal properties, knit line tensile strength, and other mechanical properties of blends. The blends that exhibited strong knit line tensile strength were considered as highly compatibilized.

Protecting Automotive Underbody Parts with a TPO-Based Powder Coating

William Tretiak*
Cymas Enterprises Ltd.

Carole Bolthouse
LyondellBasell

As part of industry-wide light-weighting goals, use of thin wall, high-tensile steel is becoming more prevalent, and is seen in underbody components that can be susceptible to corrosion. A new TPO-based powder coating has been developed that meets or exceeds end use performance requirements. The coating offers excellent long term adhesion to steel and electrocoat-primed steel parts, excellent impact and chip resistance, as well as a number of advantages over alternative coating systems.

Welding Improvements With a Focus on High Strength Glass Reinforced Polypropylene

Tim Howie
Asahi Kasei Plastics, North America

Historically, welding of semi-crystalline materials is more difficult compared to amorphous materials. When we determine the total strain energy of the material we can greatly increase the strength of the weld. Strain energy optimization will be investigated by looking at several welding parameters and the composition of the material.

Novel Glass-Fiber-Reinforced Post-Consumer Polypropylene for Under-the-Hood Applications

Deen Chundury, Ph.D.*, Cody Thompson
Wellman Plastics Recycling, USA

We present development activities of glass fiber reinforced post-consumer recycled (PCR) polypropylene products for numerous automotive exterior applications. We have evaluated both by-product PP and all PP based carpet feed-streams. We compare 100% PCR based glass fiber reinforced PP compounds to that of post-industrial and virgin-based GF/PP compounds.

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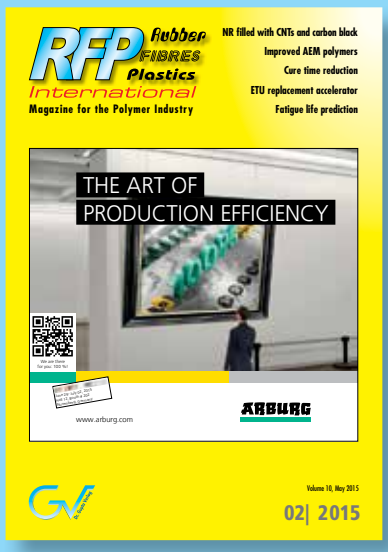

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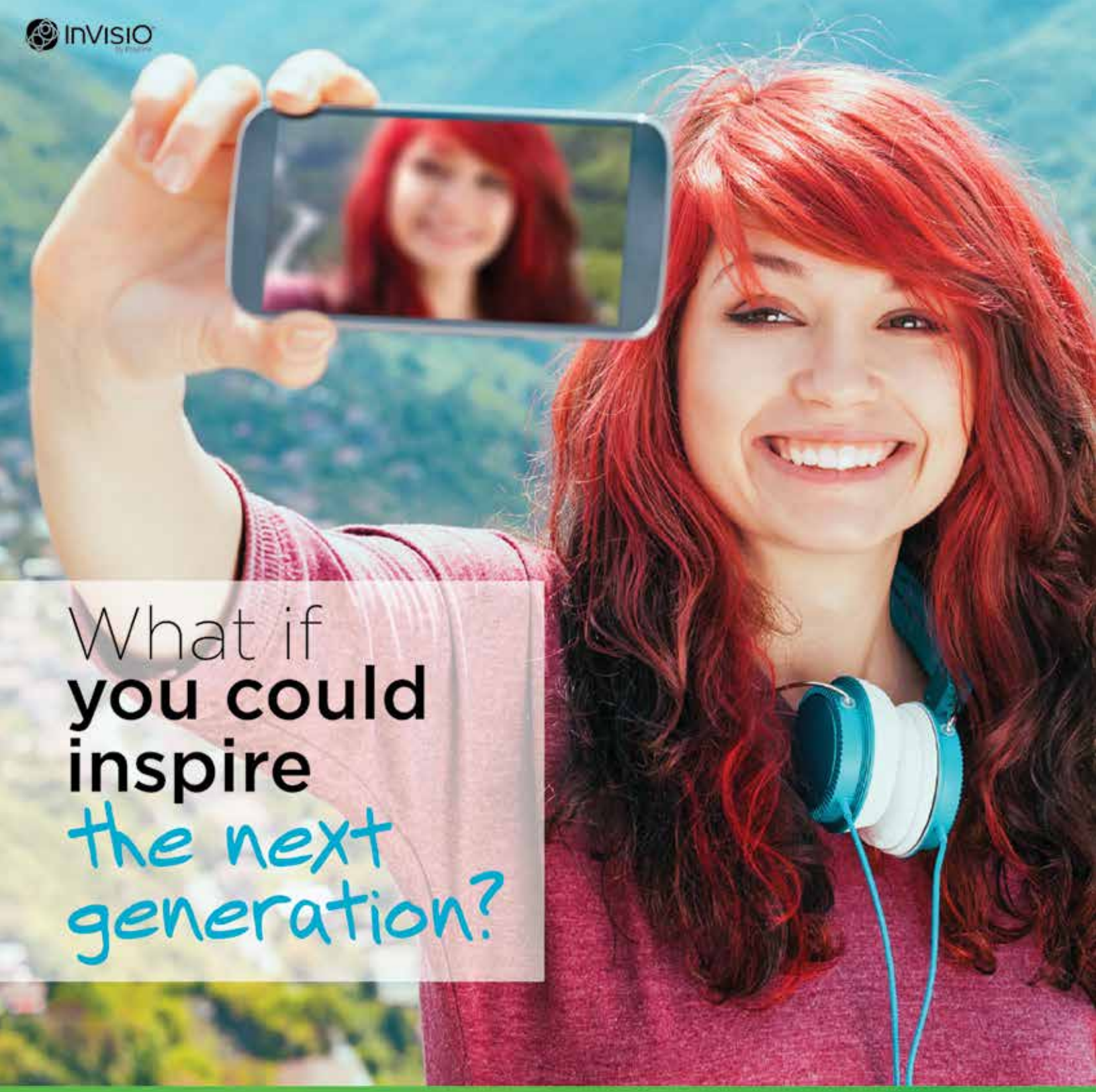

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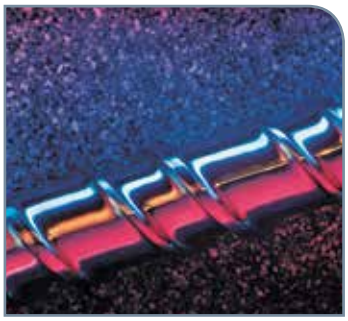

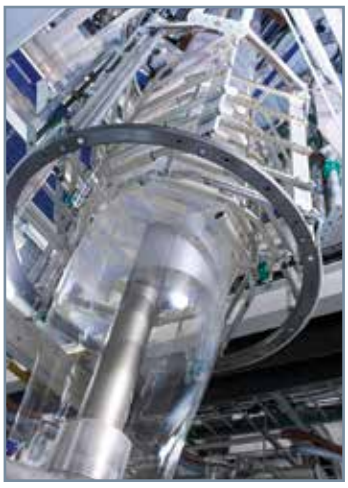

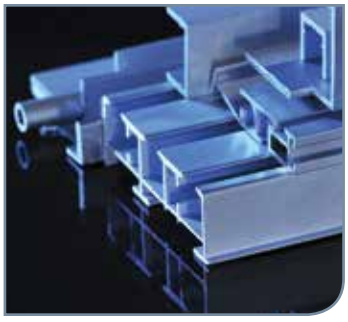

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