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AUTOMOTIVE PLASTICS News

SPE AUTOMOTIVE

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14th SPE Automotive Composites Conference & Exhibition (ACCE)

by Dr. Michael Connolly, 2014 SPE ACCE Event Chair

After a record-breaking 2013 show, the fourteenth-annual ***Automotive Composites Conference & Exhibition (ACCE)*** — jointly organized by the SPE Automotive and Composites Divisions — returns **September 9-11** to the **Diamond Center at the Suburban Collection Showplace** in Novi, Michigan. Last year's conference drew 903 registered attendees vs. our 2012 show with 636 attendees and we expect to draw a bigger crowd this year. The number of exhibitors and sponsors that supported the 2013 show was almost double that of the 2012 show, and we have broken another record this year with 75 exhibitors and sponsors. In fact, our exhibit space has been expanded twice.

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14th-annual

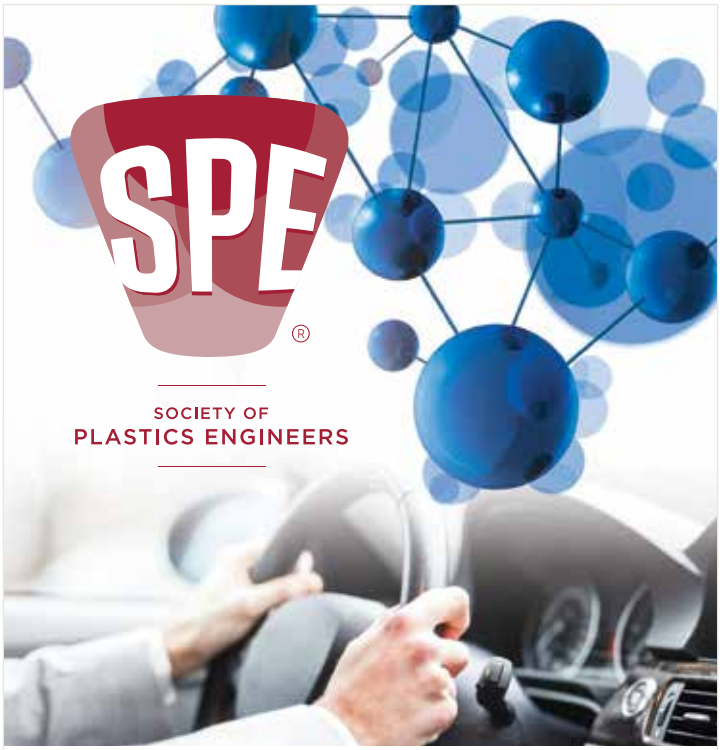
SPE AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION

World's Leading Automotive Composites Forum

SOCIETY OF PLASTICS ENGINEERS
AUTOMOTIVE & COMPOSITES DIVISIONS

SUBURBAN COLLECTION SHOWPLACE

DIAMOND CENTER



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AUTOMOTIVE DIVISION MEETING SCHEDULE & SPECIAL EVENTS CALENDAR

SPE AUTOMOTIVE

2014 SPE Automotive Div. Golf Outing
Fieldstone Golf Club — ALL DAY
Auburn Hills, MI USA — Sept. 8, 2014

14th-Annual SPE Automotive Composites Conference & Exhibition (ACCE)
Diamond Center — ALL DAY
Novi, MI USA — Sept. 9-11, 2014

SPE Auto. Div. Board Meeting
American Chemistry Council - Auto. Ctr. — 5:30 - 7:30 pm
Troy, MI USA — Sept. 29, 2014

First Round - Automotive Innovation Awards Judging
Celanese — 8:00 a.m. - 5:00 p.m.
Auburn Hills, MI USA — Oct. 2 - 3, 2014

16th-Annual TPO Automotive Engineered Polyolefins Conference
Troy Marriott — ALL DAY
Troy, MI USA — Oct. 5-8, 2014

Second Round / Blue Ribbon - Automotive Innovation Awards Judging
Celanese — 8:00 a.m. - 5:00 p.m
Auburn Hills, MI USA — Oct. 13, 2014

44th-Annual SPE Automotive Innovation Awards Gala
Burton Manor — 5:00 - 11:00 p.m.
Livonia, MI USA — Nov. 12, 2014

SPE Auto. Div. Board Meeting
American Chemistry Council - Auto. Ctr. — 5:30 - 7:30 pm
Troy, MI USA — Dec. 8, 2014

SPE Auto. Div. Board Meeting
American Chemistry Council - Auto. Ctr. — 5:30 - 7:30 pm
Troy, MI USA — Feb. 9, 2015

SPE Auto. Div. Board Meeting
American Chemistry Council - Auto. Ctr. — 5:30 - 7:30 pm
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SPE Auto. Div. Board Meeting
American Chemistry Council - Auto. Ctr. — 5:30 - 7:30 pm
Troy, MI USA — June 8, 2015

Automotive Division Board of Directors meetings are open to all SPE members. All events are listed on our website at http: speautomotive.com/ec
EMail Steven VanLoozen at auto-div-chair@speautomotive.com for more information.

CHAIR'S MESSAGE

by Steven VanLoozen,
2014-2015 SPE Automotive Div. Chair

SPE® AUTOMOTIVE

Greetings to all spe members:

I hope all of you in the Northern Hemisphere have enjoyed a wonderful summer, and those in the Southern Hemisphere haven't had too bad a winter.

On July 1 I accepted the role of chair for the SPE Automotive Division for the next year. It's my goal to bring energy and enthusiasm to this organization. I truly believe that SPE can provide real value to all of its members provided the tools and opportunities to grow both member networks and knowledge are well explained and understood.

One of the key roles SPE plays is in education. Therefore, an important and ongoing activity of our division is finding young people to foster through scholarships, travel stipends, and mentoring by those of us with many years in the plastics industry. You can read about some of this work in the following pages of this newsletter. Our Education Report details efforts in the last year to introduce local middle and high school students to the incredible diversity and importance of plastics. We know that as a result of their exposure to programs like the Plastivan® and Explorathon®, many of these students go on to pursue careers in the science / technology / engineering / math (STEM) fields. And in our ACCE update, you'll read about our newest student scholarship winners, who will return to present the results of their research at the 2015 SPE ACCE show, as well as our efforts to organize our annual student poster competition. Many of these young people will be hired right out of school because of the exposure they receive at this event.

During the next 12 months, I hope to strengthen and grow the educational outreach aspect of our charter in my role as division chair, but I will need the help of our current membership to make this happen. We all know young people who are very new to both plastics and the automotive industries and we can all help them to grow by passing our knowledge and our contacts onto them. I would ask that we remember those that mentored us at the start of our careers and that we commit to "*pay it forward*" by sharing what we have learned with our younger SPE members. I hope that if you know a young person who might benefit from the shared knowledge available through SPE, that you will let him/her know what might be gained by joining the society and the SPE Automotive Division.

The 44th-annual SPE Automotive Innovation Awards Gala will be upon us in no time and the most important thing we all can do in support of this event is to bring innovations forward for nomination. The first round of judging will take place on October 2 and 3, so please get your submissions in as soon as possible. This global event is widely covered in the automotive and plastics/composites trade press, and that in turn helps educate industry about the opportunities polymeric materials offer to reduce mass and cost, improve aesthetics and durability, increase safety, and improve life for everyone.

We have lost two huge contributors this year with the passing of Dr. Jackie Rehkopf and Ed Garnham. The efforts and positive energy both board members gave to the SPE Automotive Division and this industry will be missed terribly.

Our next two board of directors meetings will take place Monday evenings at 5:30 p.m. on September 29 and December 8, 2014 at the American Chemistry Council's office in Troy, Michigan, U.S.A. All members are welcome to attend the meeting, but we ask that you RSVP first so we ensure we have enough food.

Kind Regards,

Steven VanLoozen

Steven VanLoozen
SPE Automotive Division Membership Chair

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This year's show is shaping up to be a really strong event with 80 technical presentations, five keynotes, an executive management briefing on lightweighting and multi-material vehicles, four hours of tutorials, two evening receptions, a student poster competition, a composite parts competition, papers from three student scholarship winners from 2013, and lots of opportunity to network.

The ACCE has long been known for the diversity of its **keynotes**, which often draw upon composites innovations in other markets to highlight opportunities in automotive and ground transportation, and this year's program is no exception. The first keynote on Day 2 will be given by Prof. Jan-Anders Månson, Ph.D., head of lab, Laboratory of Polymer and Composite Materials (LTC), École Polytechnique Fédérale de Lausanne who will draw on his work consulting for the International Olympic Committee when he presents *Why Sport is Important for Automotive Composites*. Another keynote on Day 2 will be given by Prof. Habib Dagher, Ph.D., P.E., director of the Advanced Structures and Composites Center at the University of Maine-Orono, who will speak about *Polymer Composite Materials in Infrastructure Applications*. This talk will be followed by a presentation by Kestutis (Stu) Sonta, senior materials engineer, General Motors Co., on *Novel Composite Developments on the Chevrolet Spark Battery Enclosure,* a part that won the Electrical Systems category in last year's SPE Automotive Innovation Awards Competition. The conference will end on Day 3 with two additional keynotes. The first will be given by Daniel Ageda, secretary general and chief operating officer, JEC Composites Group, on the topic of *Overview & Dynamism of the Wordwide Composites Market.* Then, Matthew Marks, chair of the American Chemistry Council Plastics Division Automotive Team and senior business manager, Automotive and Mass Transportation at SABIC will discuss Plastics and *Polymer Composites Technology Roadmap for Automotive Markets*.

Returning for a third year, the **Tutorials** track helps attendees learn the fundamentals of various aspects of composites technologies — a feature that OEMs have requested to help get younger staff members up to speed on the differences between composites and metals. Tutorials this year will be held on the third day of the show and focus on long-fiber thermoplastics (session 1) and nanotechnology (session 2). Creig Bowland of Colorado Legacy Group LLC (also three-time SPE ACCE conference chair) and co-presenter, Vanja Ugresic, research engineer from the Fraunhofer Project Centre @ Western University will give a 90-minute overview on *Use of Long Fiber Thermoplastics in the Automotive Market*. During the last 30 minutes of the session, speakers will take audience questions, then open the floor to a round-table discussion on the topic. After a short break, the focus changes from macro to nano as three presenters cover a range of nanocomposite technologies in a another two-hour session. The tutorial begins with a talk by Tie Lan of Nanocor, LLC on *Chemically Modified Bentonite Clays (Nanoclay) as Plastic Additives-Applications in Automotives* and will be followed by a talk by Lawrence Drzal, Michigan State University on *Graphene Nanoplatelets: A Multifunctional Nanomaterial Additive for Polymers and Composites.* Next up, Alan Lesser of University of Massachusetts-Amherst will give a 60-minute overview on *Engineering Nano-Reinforced Composite Materials.* Each of the tutorials will be recorded, so those SPE members who are unable to attend the show in person can catch the content at a later time on the SPE International's website at http://www.4spe.org/.

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In addition to the Tutorials track, a diversity of composite materials, reinforcements, equipment and process advances, simulation and testing tools, as well as issues and opportunities are covered in nine other sessions: **Advances in Reinforcement Technologies, Advances in Thermoplastic Composites, Advances in Thermoset Composites, Business Trends & Technology Solutions, Enabling Technologies, Nanocomposites, Opportunities and Challenges with Carbon Composites, Sustainable Composites** (formally Bio & Natural Fiber Composites), and **Virtual Prototyping & Testing of Composites**.

The latest conference schedule is posted http://speautomotive.com/comp.htm. Those with smartphones or tablets running iOS® or Android® operating systems can download the free **SPE Events** app from their app store to view schedules, author bios and photos, and mini-abstracts for the 80-plus presentations, five keynotes, and other event details. A web-based version of the app also is available here: http://spe.eventsential.org/Events/Details/98.

Along with its perennially strong technical program, the SPE ACCE is also known for its lively panel discussions. This year, an executive forum co-organized and moderated by Dr. Jay Baron, president and CEO at the Center for Automotive Research (CAR) will help the composites supply chain better understand OEM perceptions about issues with implementing composites in passenger vehicles. During the last 30 minutes of the panel, audience members will be able to ask panelists questions, and this generally leads to energetic discussion and always is a highlight of the show.

Another popular aspect of the SPE ACCE are plant tours in and around the Detroit region. Currently a one-hour tour of Century Tool & Gage's facility in Fenton, Michigan will help ACCE attendees learn more about production of compression-molding tooling that is used to form parts in direct-long-fiber thermoplastics (D-LFT), sheet-molding compound (SMC), glass-mat thermoplastic (GMT), and lightweight-reinforced thermoplastic (LWRT) composites. The tour is free and a bus will transport attendees to and from the conference facility. To attend, look for eMail news updates. All attendees will be required to sign a liability waiver, surrender cameras and camera phones (if requested), follow instructions of the tour leader, and wear plant-appropriate clothing.

Learn more at http://speautomotive.com/comp.htm. Review 13 years of ACCE Archives at: http://speautomotive.com/aca.

BATTER'S BOX
Guest Columnist, Jan H. Schut

Is Thermoplastic RTM Close to Commercial?

by Jan H. Schut, Plastics Engineering Magazine
(Originally published on PlasticsEngineeringBlog.com, July 2, 2014)

For over 10 years R&D has gone on among European car makers, machine builders, material suppliers, and research institutes to adapt conventional resin transfer molding (RTM) machines from thermosets to thermoplastics. Instead of pumping two-component epoxy or polyurethane (PU) into a mold to cure, they pump thermoplastic monomer with catalyst and activators into the mold to polymerize *in situ.* The goal for thermoplastic RTM is to mass produce continuous glass-fiber-reinforced thermoplastic parts for cars, which would have advantages over thermosets of being tougher, stronger, weldable, and recyclable. T-RTM technologies are mostly focused on *in situ* molding of polyamide 6 (PA6, also called nylon 6) from epsilon-caprolactam monomer.

Because caprolactam has very low viscosity, it wets fiber structures rapidly in about 30 seconds without disturbing their position, achieving high directional fiber content of up to 65 volume %. Caprolactam, which melts at 69ºC, comes either in liquid form in heated containers or in flake form. Usually two tanks are used in a modified-RTM dosing machine. One tank is for caprolactam with catalyst, the other for caprolactam with activators and additives. The two caprolactam streams are combined typically 1:1 in a specially designed mixing head heated to around 100ºC, then pumped into an RTM mold heated to around 150ºC. The mix polymerizes in 2-5 minutes, depending on part characteristics and volume.

Caprolactam, however, isn't easy to work with. It has very low, watery viscosity of 5-10 mPas vs. 200-300 mPas for liquid PU, so leaks are an issue with conventional RTM machinery and molds designed for PU. Caprolactam also has to be protected from oxygen and moisture (<0.01%) throughout the *in situ* process since moisture slows or stops polymerization. So, continuous fiber structures have to be predried before they're put into the mold. PA 6 polymerizes to a solid using an anionic "ring-opening" polymerization reaction at over the melt temperature of the monomer, but below the melt temperature of the polymer.

LOTS OF EUROPEAN R&D

Among others, Porsche AG (Stuttgart, Germany, www.porsche.com) worked with the Fraunhofer Institute for Chemical Technology (Pfinztal, Germany, www.ict.fraunhofer.de) to develop "Cast Polyamide" thermoplastic RTM, shown at the JEC Composites show in Paris in 2006. Porsche and Fraunhofer showed the process again in 2010 at a composites conference in Germany with a demo trunk liner for a Porsche *Carrera 4*, which weighed 50% less than an aluminum trunk liner.

Volkswagen AG (Wolfsburg, Germany, www.volkswagenag.com), which bought Porsche in 2012, recently successfully tested high-pressure thermoplastic RTM molding of continuous-glass-filled PA6 "B-pillar" reinforcements that could be glued into steel B-pillar frames and weigh 36% less than high-strength steel B-pillars in production for the North American market. The tests were done in VW's fiber-reinforced plastics test plant in Wolfsburg and reported in *Kunststoff* magazine in March this year.

First an asymmetrical woven fiber structure with a sizing compatible with anionic polymerization of PA6 was preshaped in a separate mold with a binder, also compatible with caprolactam. Preforms were kept dry in a drying oven from HK-Praezionstechnik GmbH (Oberndorf am Neckar, Germany, www.hk-pt.de), then put into an RTM mold heated to 150ºC. Molding was done on an existing 1,000-ton injection molding machine using a two-sided mold, modified to prevent leakage of caprolactam. Caprolactam injection must be moisture-free, so the mold was rinsed with nitrogen each time before filling.

KraussMaffei Technologies GmbH (Munich, Germany, www.kraussmaffeigroup.com), which worked with VW, developed a new high-pressure caprolactam mixing head, electrically heated

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to about 100ºC and pumping with nearly 100 bars of pressure. KraussMaffei also modified its RTM machines for caprolactam with heated hoses to transfer melted caprolactam from dosing tanks to the mixing head. Even coupling pieces in the hoses needed heater cartridges to keep temperature constant. KraussMaffei already built caprolactam mixing heads and dosing machines for NYRIM, a reactive *in situ* casting process for PA6 copolymers, developed in the 1980s by Monsanto Co. (St. Louis, Missouri www.monsanto.com), then sold to DSM NV in the Netherlands (www.dsm.com). NYRIM puts caprolactam with activated elastomeric polymer in one tank and caprolactam with catalyst in the other, then mixes them.

KraussMaffei developed a new high-pressure mixing head and modified RTM machines to mold reactive caprolactam with catalyst and activators in situ into PA6 parts. Thermoplastic RTM could mold series automotive parts with very-high directional fiber contents up to 65%.

Hennecke GmbH (Sankt Augustin, Germany, www.hennecke.com) developed an even higher pressure T-RTM system. Hennecke optimized its counter-flow RTM mixing head for thermoset PU to mix lower viscosity caprolactam. The high-pressure caprolactam mixing head uses more than twice the pressure of Hennecke's PU mixing head, which is roughly 200 bars. Hennecke's caprolactam mixing head is self-cleaning only through counter-flow.

Hennecke developed a very high pressure T-RTM system, adapting its counter-flow RTM mixing head to mix much lower viscosity caprolactam. Melted caprolactam has a watery viscosity of only 5-10 mPas, whereas liquid PU has a viscosity of 200-300 mPas.

Engel Austria GmbH (Schwertberg, Austria, www.engelglobal.com), worked with the Fraunhofer-ICT from 2009 to 2011 to develop a high-pressure, servo-motor-powered thermoplastic RTM machine based on melting caprolactam flake in a modified injection-molding unit, not on dosing liquid caprolactam from tanks. Engel uses an Engel e-victory injection molding machine with two injection units, modified for low viscosity caprolactam with special valves and seals. This was shown for the first time at an Engel open house in June 2012, along with Engel's *in situ* thermoplastic RIM process (see http://plasticsengineeringblog.com/2014/06/11/in-situ-molding-is-more-than-a-possibility), which is also based on injection molding of caprolactam.

Batter's Box CONTINUED FROM PAGE 8

Mahr Metering Systems GmbH (Goettingen, Germany, www.mahr.com) adapted a metering machine to process reactive PA for low-pressure T-RTM casting. Mahr also recently developed a new mixing head for caprolactam, catalyst, and activator, which is self-cleaning using nitrogen. It was shown for the first time at the JEC Composites show in Paris in March. Mahr's dynamic mixing head for T-RTM uses high-precision gear pumps for process pressure from 20 up to nearly 50 bars. It is also designed for three components instead of two, allowing caprolactam to be combined with catalyst, activators, and colorants separately.

Mahr Metering Systems developed a new low-pressure mixing head for caprolactam, catalyst, and activator, which is self-cleaning using nitrogen. It's designed for three components instead of two, allowing caprolactam to be combined with catalyst, activators, and colorants separately.

Resin suppliers are working on reactive caprolactam formulations. BASF SE (Ludwigshafen, Germany, www.basf.com) worked with VW and KraussMaffei to develop reactive PA6 systems with caprolactam, catalyst, activators, and additives. BASF also has done development work for low-pressure T-RTM with Mahr. Lanxess AG (Koeln, Germany, www.lanxess.com), has done development work with Engel on thermoplastic RIM PA6 (see http://plasticsengineeringblog.com/2014/06/11/in-situ-molding-is-more-than-a-possibility). Brueggemann Chemical (Heilbronn, Germany, www.brueggemann.com), which acquired DSM's NYRIM business over a decade ago, has done development work with Hennecke.

No automaker so far has announced plans to commercialize thermoplastic RTM. Cycle time is apparently still an issue for large production quantities. "Two to three minute cycle time is OK for 100,000 parts a year," notes a researcher in *in situ* RTM at a major automaker, "but not for 200,000 or 300,000 parts a year." But a spokesperson from BASF thinks the first car parts could be in series production by 2018 or 2019.

ABOUT JAN H. SCHUT

Jan Schut has written extensively about plastics for 25 years, covering extrusion technology, recycling, compounding, and thermoforming among other areas. She was a senior editor at *Plastics Technology* magazine for 20 years, reported for a financial wire service on chemicals and plastics, and wrote a monthly column on risk management for *Institutional Investor* magazine for over a decade. She currently writes a blog and articles on new plastic technologies for the SPE (www.plasticsengineeringblog.com).

Organizers Announce Technical Program for SPE® TPO Automotive Engineered Polyolefins Conference

The sixteenth-annual ***SPE® TPO Automotive Engineered Polyolefins Conference***, the *world's leading automotive engineered-polyolefins forum*, will showcase eight technical sessions with 60 presentations on a wide variety of topics of interest to the automotive plastics community. This year's program features two new sessions (Bio-Based Polyolefins plus Interior Soft Trim: Skins & Foams) that have not been covered by the event before. Organized by the *Detroit Section* of the *Society of Plastics Engineers (SPE)*, this year's technical conference and exhibition returns to the Troy Marriott in the Detroit suburbs from October 5-8, 2014.

As Pete Grelle, president, Plastics Fundamentals Group LLC and conference technical program co-chair explains, "Our Auto TPO planning committee begins early each year searching through news outlets, events like SPE's Annual Technical Conference (ANTEC®), and by working member contacts to get a good understanding of what constitutes the leading edge in materials, process, and finishing technologies for thermoplastic polyolefin (TPO), thermoplastic elastomer (TPE), and thermoplastic vulcanizate (TPV) materials. Our members then solicit papers on these topics to highlight the evolving benefits offered by these highly versatile classes of polymers. Year after year we receive feedback from the automotive plastics supply chain that our technical programming provides real, practical value to attendees. That's a big reason why our conference keeps growing each year."

This year, the *Advances in Automotive Polyolefins* session, chaired by Neil Fuenmayor of LyondellBasell Industries and Laura Soriede of Ford Motor Co., will feature eight presentations from companies that include Nissan Motor Co. Ltd., Cytec Industries Inc., LyondellBasell Industries, Basell Polyolefinas Ltd., ADEKA Corp., the Dow Chemical Co., and Michigan State University. Covered topics include:

1. Enabling TPO to Meet Automotive Needs;
2. Next Generation TPO Materials of High Mold Flowability;
3. Challenges of the Automotive Business in South America;
4. Recycling Painted Polyolefin Parts;
5. Advanced Halogen-Free Flame Retardant Polyolefins;
6. Elastomer Development for High Flow TPOs;
7. Processing of Recycled TPO Clay Nanocomposites;
8. Advancements in Composite Structural Closures.

Mike Balow, Asahi Kasei Plastics North America, Inc. and Ermanno Ruccolo of Mitsui Plastics, Inc. will chair the *Rigid Polyolefin Compounds* session, which has eight scheduled papers from companies that include Georgia Institute of Technology, Asahi Kasei Plastics North America, Inc., Basell Advanced Polyolefins (Suzhou) Co., Ltd., Lotte Chemical Alabama Corp., Wellman Engineering Resins, Borealis AG, and 3M Co. Topics currently scheduled for presentation include:

1. Mechanical Characterization Methodologies for TPOs: Is There Room for Improvement?
2. Simulating the Effect of Processing Conditions on the Structural Performance of Glass Fiber Reinforced Composites;
3. Reducing Hazardous Substances in Passenger Cars;
4. New Trend of Car Weight Reduction by Using Long Carbon Fiber;
5. Innovative Value–Added and 100% Recycled Based Polyolefin Alloys, Blends and Compounds and their End-Use Applications;
6. Innovative Glass Fiber Applications: from Pellet to Part;
7. Aspect Ratio Engineering to Enhance Polyolefin Performance Attributes for Structural Application;
8. Functional Additives for Polyolefins.

A completely new session on *Bio-Based Polyolefins* will be chaired by Susan Kozora, International Automotive Components (IAC) Group and Dr. Ellen Lee, Ford Motor Co. The session features six presentations from Hyundai-Kia America Technical Center, National Resource Council Canada (NRCC), Weyerhaeuser NR Co., MBA Polymers UK, Magna Exteriors, and Innovative Plastics and Molding Inc. Topics to be covered include:

1. Bio Based Fillers for Polypropylene for Interior Application;
2. Polyolefin Bioplastics and Biocomposites for Automotive;
3. Breaking All The Rules (and then some!!);
4. Polyolefins Recovered from Shredded End-of-Life Vehicles;
5. Concero™: Wood Fibre Polymers for Injection Moulded Automotive Applications;
6. Utilizing Thermoplastic BioPolymers for Light Weighting Parts in the Transportation Industry.

Another new session, *Interior Soft Trim: Skins & Foams* is being chaired by David Helmer, General Motors Co. and Bob Eller, Robert Eller Associates LLC. This session features 12 presentations from speakers at Robert Eller Associates LLC, Benecke-Kaliko AG, Haartz Corp., Asahi Kasei Chemicals Corp., Imerys Talc, Toray Plastics, Sumitomo Chemical Co., University of Toronto, Vi-Chem Corp., Borealis Polyolefine GmbH/ENGEL Austria GmbH, JSR Corp., and Fiat Chrysler Automobiles/LyondellBasell.

1. Challenges and Opportunities for TPOs and Polyolefins in Automotive Interiors;
2. Comfort Aspects for the Automotive Interior;
3. Advances in Synthetic Leather;
4. Ultra-High Flow TPV SUNVIEO™ for Automotive Interiors;

TPO CONTINUED FROM PAGE 10

5. Mistrocell®, A New Effective Nucleating Agent in TPO Foamed Formulation;
6. Next Generation of New and Improved Soft Foams for Automotive Interiors;
7. Introduction of Highly Functionalized TPE;
8. Expanded Thermoplastic Polyurethane Beads: Thermal, Foaming and Sintering Behaviors;
9. New TPEs Based on Multiple Elastomeric Phase;
10. New PP Development Combined with Advanced Foaming for State of the Art Light Weighting;
11. Bonding Properties and Structures Between TPVs and EPDM Vulcanizates for Automotive Profiles;
12. CAE-Assisted Design of Instrument panels: Material Testing and Modeling for the Prediction of Laser Scoring Line Behavior in Airbag Deployment.

Dr. Rose Ryntz of International Automotive Components (IAC) Group and Jim Keller of United Paint Co. are chairing the *Surface Enhancements* session, which features eight speakers from Croda International Plc, IAC Group, Inhance Technologies, Braskem, Eastern Michigan University, Clariant, and Plasmatreat USA, Inc.

1. Novel Saturated Slip Additive with Superior Oxidative Stability;
2. The Use of IOT in Automotive;
3. Using Reactive Gas Technology to Enhance Surface Properties of TPO;
4. TPO Scratch & Mar Predictability by Simulation;
5. Polypropylene Impact Copolymers for Improved Surface Aesthetics: Rheological Characterization and Testing;
6. Emerging Technologies in Coatings;
7. Combining MuCell and Decompression Molding to Excel in Automotive Light Weighting, and Open and Low Pressure Plasma Technologies.

John Haubert, Fiat Chrysler Automobiles and Normand Miron of Washington Penn Plastics Co., Inc. are chairing the *Lightweight Polyolefin* session, which will feature contributions from eight organizations: Braskem; American Chemistry Council -Plastics Div., Washington Penn Plastics Co., Inc., LyondellBasell, SABIC, Imerys Talc, Unique Tool & Gauge Inc., and Milliken & Co.

1. Mineral Filled Polypropylene for Lightweighting Automotive Compounds;
2. Plastics and Polymer Composites Technology Roadmap for Automotive Markets;
3. Weight Reduction in Automotive Polyolefin Compounds Using Alternative Reinforcing Agents;
4. New Generation Light Weight PP Compounds Redefine Interior Performance and Weight Savings Potential;
5. All-Plastic Tailgate Design: Maximizing Weight Savings, Functionality and Styling Freedom;
6. Compounding with Mica to Reduce Noise and Vibration in TPOs;
7. Aluminum Tooling for High Volume Automotive Applications: Lessons Learned and Best Practices;
8. Newest Developments in Light Weighting, CLTE, Stiffness/Impact, Performance, and Shrinkage Control for Automotive Compounds through the Use of Additive and Filler Technologies.

The Adhesives and Coatings for TPOs session, chaired by Dr. Pravin Sitaram of Haartz Corp. and Hoa Pham of Avery Dennison Corp., features five presentations from Jowat AG, PhibroChem Animal Health Co., Avery Dennison Corp., Bostik, Inc., and Lord Corp. Presenters will cover the following topics:

1. Latest Improvements in Hot Melt Adhesives;
2. Primerless Adhesives for Non-Polar Substrates;
3. Pressure Sensitive Adhesive for Automotive Applications;
4. Hot Melt Polyolefin Adhesives for Automotive Applications;
5. Adhesive Systems for Bonding Lightweighting Substrates.

The last session, *Thermoforming of TPO Materials,* is chaired by Ed Bearse, Advanced Plastics Consultants and Rob Philp of A. Schulman and will feature six speakers from Mytex Polymers U.S. Corp., Arkema Inc., Wilbert Plastic Services, Monark Equipment Technologies Co., and A. Schulman. Topics to be covered include:

1. A New Glass Fiber Reinforced Thermoforming TPO;
2. Enhance Heavy-Gauge Thermoformed Products with Solarkote® T Acrylic Capstock System;
3. Thermoformed Twin Sheet Parts for Transportation;
4. Advances in Thermoform Machinery;
5. New Caps for Extruded Sheet;
6. High Gloss Molded In-Color Exterior Thermoformed Parts for Hyundai.

As Dr. Norm Kakarala, retired, Inteva Products LLC and conference technical program co-chair added, "For this year's conference, we've assembled a solid program featuring rigid and elastomeric TPOs and TPEs for interior and exterior applications in passenger vehicles. The focus is on how these materials reduce weight and cost, enhance aesthetics and haptics, offer greater molding and forming efficiencies, and generally help automakers do more with less. These are very important and desirable properties at a time when OEMs are working extremely hard to meet pending fuel-efficiency and greenhouse-gas emissions targets. Given our significantly expanded exhibit area and excellent technical program, we expect this year's show to draw even larger crowds than in 2013."

Learn more at http://auto-tpo.com/ or http://speautomotive.com/tpo.htm.

OCT 5–8, 2014

TPO: Gateway to Innovations

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Fred Deans and his son, Jeffrey

An Engineer's Life...

by Frederick S. Deans, P.E.

If you had told me when this all started that I would have an Engineer's Life, I would have given you a puzzled look and asked you what you were talking about. That would have been in 1964, when I was a junior in Bethel Park High School, Bethel Park, Pa. In fact, the aptitude tests given by our high school guidance councilor led me to believe that I was either going to run a hardware or an art-supply store. (I still get a warm feeling when I enter Greene's Art Supply Store in downtown Rochester, Michigan) Well, how did this engineering makeover happen?

Several transformational influences happened to me. First, my high school had an excellent college prep program that had a strong math, science, and humanities curricula. Taking that program put me on a path toward college. Second, to earn some spending money, I did odd jobs around our neighborhood for several families – I mowed lawns, raked leaves, shoveled snow, these are the kinds of all-year around jobs you could do in the Pittsburgh area. Most of the client family fathers were professional people, that is to say, they were engineers. They began to ask me what I was going to do with my life and why wouldn't I pursue an engineering degree? And, of course, I met Linda, who graduated a year ahead of me and for the last 50 years has been the steadying influence in my life (and Jeffrey's mother – more on this later.)

Phillip Ross, one of my lawn, leaf, & snow clients, was at the time the plant manager of Westinghouse Bettis Atomic Energy plant in Westmoreland, Pennsylvania. One day, Mr. Ross asked me what I was going to major in when I went to college. I told him I didn't know. He then said that if I got a Mechanical Engineering degree, he would hire me when I graduated from college. Well, that made up my mind. It was off to an M.E. degree for me.

In 1969, I selected Valparaiso University in Valparaiso, Indiana, which had had a small (200-student) Civil, Electrical, & Mechanical Engineering school. Valpo also offered me a scholarship, job, loan, and grant that paid the whopping $2,200 USD/year room, board, and tuition costs. (You can't believe the costs now!) Valpo had some very unique educational advantages – class sizes were small and taught by full professors (no grad student assistants), each professor (all males) came from an industry background and regularly shared his non-academic experiences with us, and all the engineering students learned to support each other. Academic competition was important, but learning to work and help each other was more important.

After four years, with my BSME degree in hand plus a marriage to Linda, who graduated a year ahead of me with a degree in Chemistry, I headed back to the Pittsburgh area for that promised job at Westinghouse. I arrived for an interview at Bettis and told the human resources interviewer that Mr. Ross was my recommended contact. I was then told that Mr. Ross no longer worked at Bettis (oops!). But then I learned he had recently been promoted to vice-president and general manager of the division. The interviewer left the room, came back after 10 minutes, and said he had called

An Engineer's Life CONTINUED FROM PAGE 14

Mr. Ross at his central office location. He was told to offer me a beginning engineer's position and he then asked me when could I start. All right!

Then something strange happened. I began to ask questions about the positions. They all required that I pursue a Ph.D. in Engineering. I wanted to use my new found "engineering expertise" right away, so going for a Ph.D. wasn't in my plans. I thanked Westinghouse and Mr. Ross and pursued other opportunities. I ended up accepting a production engineer's position at PPG Industries Works 1, Automotive Windshield plant, just north of Pittsburgh. My responsibilities included "cold end" processing (where flat glass was cut and edged) and the Plastic Department, where the polyvinylbuterate (PVB) laminate interlayer materials were processed. Interesting material this PVB: it had remarkable impact behavior. Here was my first experience with plastics, but certainly not my last.

After four years at Works 1, I was asked to move to PPG's General Office to become a Glass Division technical service engineer. This was a neat job. I got to work on every major architectural project in North America at the time: from Peachtree Plaza in Atlanta to the Renaissance Center in Detroit, to CN Tower in Toronto to Sears Tower in Chicago to Bonaventure Plaza in Los Angeles. There's a lot of engineering involved in window curtain-wall programs – heat transfer, wind and thermal load analyses, hail-stone impact, and building code and safety glazing compliance to start with. We introduced the industry's first computer-aided software for window glass selection for major building projects. I also got involved in PPG's Solar Collector program. PPG's solar collectors were insulating glass windows with a water heat exchanger attached to them. That entailed lots of winter trips to PPG customers in Florida, Southern California, and Hawaii. (What a great job!) And this is where I learned that in business, if you are technically correct but commercially wrong, you're still wrong.

In 1979, some manager at PPG thought I needed some sales experience, so, off I went to Detroit to become an OEM Glass sales representative. I was given the GM Chevy Truck & Bus account, a small portion of PPG's GM OEM business. There wasn't much engineering here. Once a year, I quoted PPG's next year's auto-glass prices. We lost business or we gained business. Fortunately for me, we gained more than we lost. My job was more about glad-handling purchasing people than solving problems. I felt something was missing in my job. You guessed it, where did the engineering go?

In 1985, I met Sheppard Sikes, general manager of PPG Fiberglass and AZDEL Products. One day he stopped by my office and told me that I was wasting my life away as a sales guy and that I should consider becoming an AZDEL application development engineer. Alright, I'm back in the engineering realm. By the way, what are FEA, shear-edged compression mold, CRASH and NVH analyses, and long-fiber thermoplastic composites? All these I would learn in my experiences in the wonderful engineering world of composites. The PPG AZDEL experience lasted one year. In 1986 two important changes happened. First, GE Plastics (GEP) bought half of the AZDEL business, so off I went to GEP and a joint venture of equals – yeah, sort of like DaimlerChrysler. And second, our son Jeffrey came along. (What do 39-year old, first-time parents know about parenting? It truly has become my life-long engineering assignment.)

Going from PPG to GEP was like going from a merry-go-round to a roller coaster. The rides both take the same length of time, but there were a lot more topsy-turvy dizzy spells with GEP. My assignment at the new joint venture was to handle glass-mat thermoplastic (GMT) bumper development. Here, the composite gods smiled on me. This time, it was in the form of the *Honda Accord* uni-directional bumper program. In the mid-1980s, the Insurance Institute for Highway Safety (IIHS) bumper impact test rated the *Accord's* steel bumper impact as very poor (i.e. expensive to repair even after a mere 5 mi/hr (8 km/hr) impact). The engineers at Honda came up with a very unique bumper design that eliminated the shock-absorber attachments and introduced a simple "pin"-type, "0-bending moment" attachment system. (The beam had to absorb a significant amount of impact energy.) What was needed was a molded composite bumper beam. Honda selected AZDEL's unidirectional GMT material, which was a new material at the time. As the program manager, It was my job to not only come up with the best composite material, but to convince Honda and AZDEL management that we had the best process, quality control, and suppliers who could support a global program. After a short 18-month development and testing program, the

An Engineer's Life CONTINUED FROM PAGE 15

Accord composite bumper beam was launched. It was a single 12-million lb/5.4-million kg application program. And within three years, every other Japanese OEM had an AZDEL bumper beam. Let's hear it for GMT!

Well, it seems that no one lasts forever at GEP, not even GEP itself. In 1992, I began a 16-year job odyssey that finally ended with me retiring from Hanwha AZDEL, which had bought the business from SABIC - PPG, which had acquired GE's Plastics business in 2007. In 2008, my life-long friends, Tom Russell and Al Murray and I became business partners in a startup venture called Allied Composite Technologies. ACT, as we call it, does consulting and technical/business management support for a variety of clients. We specialize in developing new materials and applications in the transportation, building & construction, and infrastructure markets. And I'm happy to note that there's lots of engineering there.

So how does an Engineer's Life fit in my last 45 years? I believe engineering is just as much an attitude as it is a process. It gives one the character to stand up to challenges — be they on the job or personal — and face life with an "I can solve this" approach. Engineering is basically a process that breaks down large, complex problems (otherwise known as opportunities) into smaller, easier to solve, less complex problems. Engineering gives you the tools and the aptitude to tackle complex problems with a take-no-prisoners attitude. Engineers have a bit of a swagger when it comes to approaching every-day challenges…not that I think we're better than anyone else. In fact, I am a very-low ego and humble engineering guy.

Now, here's where engineering and Jeffrey, my son come together. From a very young age, I would expose engineering as a way of life to the "Boy." I also had other adults tell him that engineering was a neat deal. Low and behold, when he graduated from high school, he told Linda and I that he wanted to enroll in Michigan State University's Engineering program. Four years later, he graduated and accepted a job as a process engineer at Ford Motor Co. And now days he's a senior process engineer at Unilever's Hammond, Indiana plant. Of course, I give his mother most of the credit in his upbringing. My contribution? Let's call it an Engineer's Life.

ABOUT FRED DEANS

Frederick Deans is currently the chief-marketing officer and a principal of Allied Composites Technologies, LLC (ACT) as well as the owner of F. Deans & Associates, a Michigan-based enterprise. Deans also is a long-time member of the board of directors of both the Automotive and Composites Divisions of the Society of Plastics Engineers International. He is past-chair of the SPE Automotive Composites Conference & Exhibition (ACCE) from years 2001 and 2004. Deans also has been given the SPE Honored Service Member award in 2003 and the SPE Composites Person of the Year in 2006. He is a licensed professional engineer in the Commonwealth of Pennsylvania. Deans holds a BSME degree from Valparaiso University and an MBA degree in Business Administration from the University of Pittsburgh. Throughout his career, he has had responsibilities as a production engineer, technical service engineer, sales manager, market & industry manager, and director of new business development covering the automotive, industrial, materials handling, and building & construction sectors.

OEM Corner

by Peter Bejin,

Manager-North American IP Console, Ford Motor Co.

The automotive business is a competitive high-stakes environment. Potential customers who walk into our showrooms demand a great deal from our products. It is our mission to ensure that our customers are completely satisfied with class-leading performance at every level, from quality to detailed execution and overall performance, all at the best value. We know that when our customers purchase a new vehicle, it is typically the second-most significant one-time purchase in their life, and they will be living with, and spending time in their vehicles for a long time. As a result, purchase decisions can also be very emotional, so the design and design leadership are also very critical elements in a customer's purchase decision.

It is amazing to look at the progression of design over the years and plastics' impact on both design leadership and design freedom. My father use to own an old *Jeep*® circa 1950. The dash was steel, the rear bench seats were steel, the floor was steel, and there was no center console. The only plastic it had was the vinyl covering on the seats and the plastic knob on the shifter. The vehicle literally was a steel box on wheels, and at 12 years old I thought it was pretty cool. However, customers today have more mature preferences than the typical 12-year-old boy, and without plastics we would not have nearly the progressive or safe products we have on the road today.

Plastics enable the design and engineering teams to work together to create the most appealing surfaces both inside and outside our vehicles. Our exteriors have used plastic fascias in the front and rear for many years; however injection-molding technology has enabled integration of components such as the grille and integrated modules through the use of higher strength polymer composites, which also reduce mass and improve low-speed impact performance. The use of plastics in headlamp lenses also has helped create more emotive design and shapes, reduced weight, and greatly reduced breakage.

Our exterior details are enabled with plastics too by replacing the large clunky radio antenna with sleek color-keyed shark fins.

And we have leveraged plastics more in liftgates with all-plastic integrated components to enable design while at the same time save weight (reducing the forces needed by consumers to open/close the door) and reduce cost. Plastics are used in sacrificial panels on our deck lids so if you are involved in a collision only the plastic panel needs to be replaced instead of larger more expensive panels. This also gives more freedom to deliver class-leading shapes that lower service costs and save weight vs. steel.

As we transition to the interior, the impact of plastics is even more extreme. In addition to all the design freedom, weight, safety, and cost savings that plastics helps deliver, the effect is more subtle in delivering refined vehicle interiors that people love.

Furthermore, plastics have been transformational from a safety perspective. This versatile class of materials is key to airbag systems, which came onto the scene in the 1970s, became mainstream in the 1980s, and are proliferating to this day with modern airbag curtains and inflatable seat-belt systems that all are enabled by plastics.

OEM Corner CONTINUED FROM PAGE 18

Not only do plastics make our vehicles safer, they also deliver refinement. The freedom to grain a plastic part has a greater impact on perceived quality than most people appreciate. Smooth grains convey refinement and elegance when touched. Deeper animal grains convey a level of toughness and ruggedness. More recently we have used technical grains to convey a more progressive feel. Some grained plastics can emulate other materials, such as stitched leather or polished aluminum. The bottom line is that there is no end to what the industry can do with grain; the only limit is our imagination.

And just think about how something as simple as lowering the gloss level and reducing glare on an instrument panel can contribute not only to better vision, but also to the harmony and inner calm of a vehicle interior; or how important haptic feel has become and how plastics have contributed to that; or how plastics have enabled LED (light-emitting diode) lighting, which offers greater functionality with less energy and far longer service intervals. For example our *Lincoln* doors turn on puddle lamps when the door is open so people can see better in the dark, and interior ambient lighting makes it easier for people get in and out of the vehicle in low light.

Many may believe that the use of plastics in a vehicle's interior detracts from delivering a premium feel (favoring real leather or metal or wood, but nothing could be further from the truth. Most cloth wrapped pillar trim is back-injected with plastics for efficiency, and most wrapped parts are vinyl or TPO foam-backed fabrics. Finish panels that are plated, filmed, or molded in color are all enabled with plastics. And there is a growing trend in plastics to use molded-in-color (MIC) metallic vs. paint. Delivering the same level of appearance without paint not only reduces cost, but it is far better for the environment because it eliminates all the volatile organic compounds (VOCs) and high-energy bake ovens associated with the painting process. Furthermore, the highly polished tool required to produce MIC metallic delivers a much smoother, dryer feel than the rough uneven feel of real painted surfaces. Even small details like the rubberized touch points on radio controls and registers are enabled by plastics.

Clearly plastics has helped move the automotive industry into a new age of design leadership. From bumper to bumper and from pillar to pillar vehicles today are a testament to the power of plastics. And there are thousands of little innovations every day under the plastics umbrella that push the envelope to help us deliver the most exiting products for our customers.

ABOUT PETER BEJIN

Peter Bejin is the manager for North American IP Consoles for Ford Motor Co. in Dearborn, Michigan, a position he has held since July 2012. Previously, he was manager of Global Craftsmanship stationed in Merkenich, Germany. During his career at Ford, Bejin has held a number of positions in Design & Release Engineering as well as Quality. Before joining the automaker, he worked as a plastics engineering co-op at (then) GE Plastics in Southfield, Michigan. He holds 12 patents in plastic-enabling technologies. Bejin earned Bachelor's and Master's degrees in Engineering from University of Michigan-Ann Arbor and an MBA from University of Michigan-Dearborn. He lives in Northville, Michigan with his wife, Gigette and two children, Peter and Alex, as well as two dogs, Oreo and Coco. In his free time, he enjoys hunting, fishing, biking, and running.

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SPE AUTOMOTIVE

Service through Science

by Dr. Libby Berger

General Motors R&D

I was asked to write a short essay about how I ended up majoring in chemistry, what my other training (academic and otherwise) has been, and how it has all been useful in my life, particularly at General Motors R&D. Early in my life, I realized that one of my abiding life themes was that I don't like straight lines. I would like to tell you that I was born with a passion for chemistry, and fought tooth and nail to be able to follow my dream, but it wouldn't be true. I kind of fell into it, although chemistry did turn out to be an excellent dream.

I grew up in Kansas, in a suburb of Kansas City. I didn't know any scientists and very few engineers. Thus, chemistry was not something I considered a normal career choice. I always liked sciences in school, but then I liked most of school. I also liked English and social studies and math and orchestra, although I have to admit that I was much better at the math and English part than I was at the violin. In junior high school, I started getting the idea that I was a little weird – girls weren't supposed to like science or math. For example, we did a "Careers" unit, and the careers were divided into "boys' careers" and "girls' careers." Now, it was ok for the girls to look in the boys' folder, but it was still considered strange. And, of course, most of the careers I was interested in were in the boys' folder! (Come to think of it, I don't remember if the boys were allowed to look in the girls' folder either.)

Another example: I was in advanced math through my junior year of high school, but didn't take calculus my senior year. Nancy Ann, the only other girl in the class, wasn't going to take calculus, so I didn't either. I was okay with being one of two, but I didn't want to be one of one.

In college (University of Kansas), things got more egalitarian, but I still had no idea what I wanted to do with my life. I started my junior year as a Classical Greek major. The year before I had briefly thought about Physical Therapy, and had to take chemistry for that. I figured I would take "real chemistry" instead of "kiddie chem," and ended up with the best teacher I ever had, Prof. Clark Bricker. Not only was he brilliant, but he really cared about each of us understanding the fundamentals of the subject. So even though I was a Greek major, I kept taking chemistry. Part way through Organic Chemistry, I realized that even though there were a fair number of other women in the (very-large) lecture hall, there were no other Classical Greek majors. I also came to the conclusion that even though it was considered gauche to think about getting a job after graduation (yeah, this was a long time ago), there was a better chance of being able to support myself as a chemist than as a classicist. Then I took Physical Chemistry, which fit my brain a whole lot better than Organic Chemistry, and from there I decided that a Ph.D. was my next goal.

In retrospect, my method for deciding on a graduate school was a little random. I tore off all the grad school postcards that were displayed on the bulletin board outside the department office (did I mention that this was a long time ago?), and sent them in for information. I decided to apply to several of the schools, and got accepted to Rice, Case Western, and Penn State universities. Then I went to talk to a couple of my University of Kansas professors to get their advice. They said that these schools were fairly comparable, so I ought to look at specifically who the professors at each school's Chemistry department were, what kind of research they did, and what their reputations were. They also suggested I consider where I wanted to live. When it came down to a decision, I decided I would rather live in the middle of nowhere in Pennsylvania than in the middle of Cleveland or Houston.

So I waded my way through grad school at Penn State in Physical Chemistry, doing research for Prof. Bob Bernheim on quasi-elastic light scattering of polymer solutions. I admit to not having any idea what I was doing during the first couple of years of my doctoral work, but I did finally get it figured out, and graduated with a Ph.D. five years later (which was about par for P Chem majors at the time).

By that time, I had acquired a very-good friend (we shared a laser lab at Penn State) who was to become a very-good husband. So we had to get the geography right. He was working at Owens Corning Fiberglas in Granville, Ohio, and I was also very lucky to get a job there. We bought a house, had a couple of kids, and I delved into the (usually) great life of being a working mom and wife. Five years on we got restless at OCF. It took us a little while to get the geography right again for another move, but we did, eventually. I found a job that was as close to my dream job as I ever hoped to get: General Motors Research Labs (GMR, now GM Research and Development).

Service through Science CONTINUED FROM PAGE 22

GMR even wanted me to do the research that I wanted to do. I had been working at OCF on the fiber/matrix interface for fiberglass/epoxy composite systems. It turned out that the Polymers Department at GMR was interested in the same issue, and was just fine with the way I wanted to approach the subject. That was close to 30 years ago, and I (usually) still love it.

You may have picked up that my Ph.D. topic was quasi-elastic light scattering. Yeah, I am really a laser spectroscopist, or at least I was. Getting back to those not-very-straight-lines that I travel, I went from lasers to fiber-wetting balances to adhesives to composite materials. Each step made a lot of sense at the time, and I have had the joys and frustrations of many different research topics and situations. I have spent a lot of time representing GM at USCAR, (the United States Council for Automotive Research, a pre-competitive consortium of GM, Ford Motor Co., and (the now) Fiat Chrysler Automobiles), where I have learned an amazing amount and made many good friends. And I've been able to bring a good bit of consortium knowledge back into GM to make our vehicles better. While I am still frequently the only woman in a room full of men, I am also occasionally part of an all-female team of scientists and engineers that just happened to come together that way. And I have learned a few things that I would like to share with you. Most of these are not terribly original.

- Although I am pretty smart (as I assume you are, if you are reading an SPE newsletter), there are a whole lot of people a lot smarter than I am. That's strangely comforting, since I am getting a pretty good idea of how much I don't know, and how much the world needs that knowledge. Someone needs to be able to not only find out all that knowledge, but also figure out the best ways to use it.
- Smart isn't the only thing that matters.
- Learn how to synthesize. (Yeah, I am a chemist, but I am not talking about just playing in the lab.) Take a bit of knowledge from here, a bit from there, put it together and see what you get. Then throw something else in that is completely different. And sometimes take it out again. Even reading Classical Greek will train your brain to see things a little differently, and may help you approach a difficult project from another angle.
- Even a research engineer needs to be able to get along with people. Maybe especially a research engineer. Most of us are rather quirky, which is part of what makes us good researchers.
- Getting to know a variety of people from a variety of sources is not only good for you, it makes you a better employee, friend, spouse, parent, committee chair at the elementary school or church, and whatever else you want to be in life. This includes getting to know men, women, children, teenagers, and old people, as well as people of other races and socio-economic backgrounds from other countries, and even from different political and religious persuasions.
- Your boss isn't as bad or as good as you think he/she is. I have had seven, no, eight immediate bosses in my professional life. Some I have thought at the time were great, and looking back now realize that they had major flaws. Some I thought were terrible, and then realized they were doing an amazingly good job in a terrible situation. I'm pretty sure all were doing the best they could. And I am guessing some thought I was a great employee, and some thought I was a terrible employee. (Both may have been true.)
- Take care of your family and your friends. They are more important than your job.
- You need to enjoy what you do. Not every day needs to be filled with sunshine, and occasional grumping to your spouse about xxx or yyy doesn't count, but if you are miserable at the thought of going to work every day, you need to find something else to do.
- The title of this column is "*Service through Science*." Do you think that the world is a better place for your having been here? Have you succeeded in improving the environment a bit (possibly by using composite materials to lightweight vehicles, and thus decreasing our carbon footprint), or working on better cures for cancer, or engineering better prosthetics (which too many of our returning soldiers need), or teaching the next generation of scientists, or synthesizing a new varnish that improves the sound of a violin? You have unique talents, and they need to be put to good and purposeful use.

I consider myself a very lucky woman. I have a career that I love, a wonderful family, great friends, decent health, and a bunch of hobbies that I enjoy. What did I do to deserve all of this? Yeah, I work hard, but so do a lot of other people. Yeah, I'm smart. See above. Yeah, I'm _____ (fill in the blank). So are a lot of other people. Most of it is the luck of the draw, and guessing right. Remember that when you see someone having a really *lousy* time in life.

ABOUT LIBBY BERGER

Libby Berger has a B.A. degree in Chemistry from the University of Kansas, and a Ph.D. degree in Physical Chemistry from the Pennsylvania State University, where she studied quasi-elastic laser light scattering. She began her career with Owens Corning Fiberglas working on sizing emulsions and fiber/matrix interface properties, then moved to General Motors. At GM, she has worked at Research and Development on adhesives and structural composites, including fiber/matrix interactions, preforming, molding, and characterization of both carbon fiber and glass fiber composites. The production-level projects she has been able to contribute to include the *Silverado* composite truck box and the carbon fiber *Corvette* hood. Since 2000, she has been very involved in the Automotive Composites Consortium and the U.S. Automotive Material Partnership, under which she is currently co-principal investigator on the U.S. Department of Energy-sponsored Validation of Material Models for Carbon Fiber Composites project.

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Scholarship Awards

Announcing the Winners of 2014-2015 SPE® ACCE Scholarships Sponsored by Michigan Economic Development Corp.

A remarkable group of graduate students with international academic or work experience was selected for this year's ***SPE ACCE Scholarship Awards*** for the 2014-2015 academic year. The scholarship were graciously sponsored by Michigan Economic Development Corp. (Lansing, Michigan). Winning students whose composites-intensive projects were judged to have the greatest potential impact on ground transportation were Markus Downey of Michigan State University, Fatimat Oluwatoyin Bakare of University of Borås, and Sebastian Goris of University of Wisconsin-Madison. Each student will receive a total scholarship of $2,000 USD and will return to present the results of his or her research at next year's SPE ACCE show, September 9-11, 2015.

Markus Downey, who is working on a Ph.D. degree in Chemical Engineering at Michigan State University (East Lansing, Mich.), won the scholarship for a student enrolled in a Michigan institute of higher learning with the topic: *Hybrid Toughening of Aromatic Epoxy Polymers via Graphene Nano-Platelets and Aliphatic Epoxy Copolymers: Optimized Fiber-Reinforced Polymer Composites for Lightweighting.* Explaining how his work is applicable to ground transportation Downey says, "Fiber-reinforced polymer composites will play a significant role in the lightweighting strategies required to meet the new U.S. Corporate Average Fuel Economy (CAFE) standards. My proposed research will look at hybrid-toughening of fiber-reinforced polymer composites by toughening the fiber/matrix interface with aliphatic epoxy co-polymers alone or in conjunction with graphene nanoplatelets as well as toughening the bulk matrix with low concentrations of aliphatic epoxy co-polymers – two typical areas of failure in fiber-reinforced polymer composites. Through targeted improvements of both the sizing (coating) on the reinforcing fibers and the surrounding polymer matrix, the energy required to propagate cracks in each of these areas should be increased to yield a substantially toughened composite. This, in turn, can help reduce the amount of material needed for a given application, leading to weight and cost savings, or it can possibly broaden usage in new areas of the vehicle, particularly if the composite shows mechanical properties not previously attained."

Downey earned a B.A. degree in German and a B.S. degree in Chemical Engineering, both from the University of Rhode Island (URI, Kingston, R.I.) in 2002 as part of the school's International Engineering Program (a five-year dual-degree program). After completing his undergraduate education, Downey stayed at URI and worked on fatigue life improvement of thermal spray instrumentation and thermal barrier coatings as part of his M.S. degree in Chemical Engineering, which he was awarded in 2004. After graduating, Downey spent eight years working in the exhaust gas after-treatment industry, the first two years of it in Germany with Emitec GmbH as a research engineer. Coming to Michigan to work as a technical applications engineer for Emitec Inc., Downey successfully expanded the large-engine and locomotive business of the company. Now a full-time student starting the third-year of his Ph.D. studies in Chemical Engineering at Michigan State University, Downey works in the Composite Materials and Structures Center where his focus is on toughening fiber-reinforced polymer composites and polymer nanocomposites for high-performance applications. He has published several papers in conference proceedings and has give presentations at technical conferences in the U.S. and China. He also is a U.S. patent holder.

Originally from Nigeria and currently working on her Ph.D. degree in Materials Science/Polymer Engineering at the Swedish Centre for Resource Recovery at the University of Borås (Borås, Sweden), **Fatimat Oluwatoyin Bakare** won a scholarship for her proposal on *Synthesis of Bio-Based Composites with a Lactic Acid Based Thermoset Resin from Lactic Acid and Allyl Alcohol*. Explaining how this work is important for the transportation industry Bakare says, "There have been increased interests in the use of biomass and its derivatives to provide alternatives to fossil fuel resources to reduce environmental risks and improve global sustainability. Biomass and its derivatives can be used in the production of polymer and composite materials, leading to weight loss and gains in fuel efficiency. We have previously reported synthesis of a thermosetting bio-based resin prepared by direct condensation of pentaerythritol, itaconic acid, and lactic acid. This resin had relatively good mechanical properties, but its relatively high viscosity caused poor wetout and impregnation of reinforcements, leading to lowered mechanical performance. Hence, a new resin with lower viscosity that would provide better impregnation of reinforcements is needed. The goal of my new research is to investigate the technical feasibility of a resin based on lactic acid and allyl alcohol combined with natural fiber reinforcement."

Bakare has been a lecturer at Lagos State University (Lagos, Nigeria), in the Department of Chemical and Polymer Engineering since 2009, where she earned her B.S. degree in Chemical and Polymer Engineering in 2004 with honors. She studied Industrial and Production Engineering at University of Ibadan (Ibadan, Oyo, Nigeria) in 2006 and graduated in 2008 with an M.S. degree. She currently is a postgraduate student at University of Borås working towards her Ph.D. degree under the supervision of Prof. Mikael Skrifvars and co-supervisor, Dr. Dan Åkesson. Bakare has taught at the collegiate as well as high school level, sat on many academic committees (including community service work), and supervised exam projects. She also has worked as an industrial attaché and laboratory technologist for a quality-control laboratory supporting the textile industry. She has had two journal articles published, and has three more awaiting publication. Papers she has authored or co-authored also have been featured in five different technical conferences to date. And she has five times been a scientific journal referee for the *Journal of Applied Polymer Science*. Bakare is a past vice-president of the student chapter of the Nigerian Society of Chemical Engineers and Polymer Institute of Nigeria. She speaks English, Yoruba, and some Swedish.

Originally from Germany, **Sebastian Goris** is working on a doctorate in Mechanical Engineering at University of Wisconsin-Madison (UWM, Madison, Wisc.) and won the third graduate scholarship this year with a research project entitled *Contribution to the Understanding of Fiber Motion in Compression Molding of Long-Fiber Thermoplastics*. Explaining the significance of his topic Goris says, "Compression molding of long fiber-reinforced thermoplastics (LFT) composites is a widely used process to produce semi-structural parts with a desirable balance of low weight, good mechanicals, and cost-efficient manufacturing. However, the final state of the fibers greatly impacts the local and global properties of the finished part and has to be carefully considered, although currently there is no software tool able to predict fiber-matrix separation and fiber dispersion within a molded part. In our group, a mechanistic model has been developed that represents each fiber as a chain of interconnected segments and takes into account excluded volume forces, drag forces, fiber-fiber interactions, and fiber elasticity. For my research, I will introduce this model for an extensive study on fiber attrition, fiber dispersion, and fiber-matrix separation in LFT compression molding. Simulation results will be verified to aid in the understanding of fiber-fiber and fiber-matrix interactions. A more accurate prediction of the anisotropy and heterogeneity within compression-molded LFT parts will provide the foundation for reliable structural analysis and hence improved automotive part design."

Goris holds a B.S. degree from the Department of Mechanical Engineering at RWTH Aachen University (Aachen, North Rhine-Westphalia, Germany). While completing his undergraduate degree, he focused on polymer processing and worked as an undergraduate research assistant at the Institute of Plastics Processing (IKV) at Aachen University. In 2012, he received a full one-year scholarship from the German Academic Exchange Service (DAAD) to attend graduate school at UWM where, under the direction of Prof. Tim Osswald at the Polymer Engineering Center, Goris completed his M.S. degree in Mechanical Engineering and now is working towards a Ph.D. degree. Papers Goris has either authored or co-authored already have been published in four conference proceedings and a chapter on *Composites Manufacturing Processes* for the Mechanical Engineering Handbook, 3rd edition, is currently under revision. His work has been featured on posters and presentations given at conferences in the U.S., Germany, and Israel. He will be a conference reviewer at the 3rd Young Investigators Conference and the 6th German Association of Computational Mechanics in Germany next year. He was honored with an Academic Achievement Award from the Division of International Studies and International Services at UWM this year, and last year Goris received a second-place award in the Ratner Award Competition for course project in Engineering Management of Continuous Process Improvement at UWM. In 2013 he also attended a Wisconsin Entrepreneurial Bootcamp (WEB) at the Wisconsin School of Business. While still at Aachen University, Goris was a mentor for international students in the BeBuddy project and during his first year at UWM, he was a volunteer ambassador for Aachen University. He has been a member of SPE since 2012. After graduation, he plans to work in the automotive industry working on developments in polymer and composite processes.

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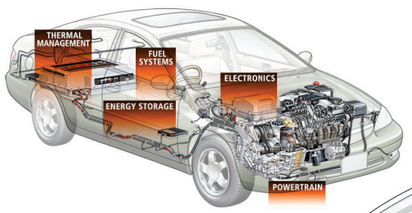

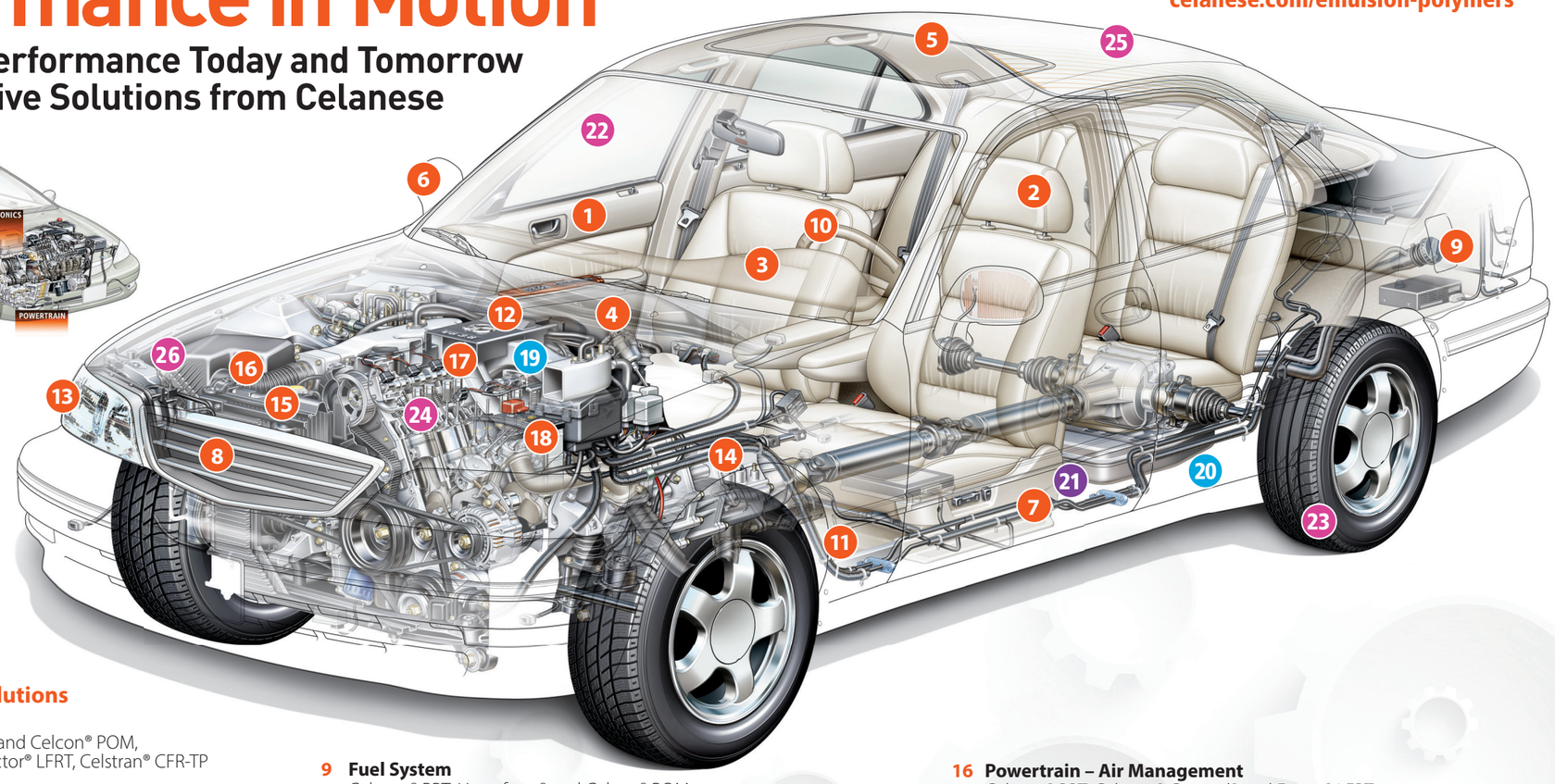

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Jackie Rehkopf

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AUTOMOTIVE

ANTEC® REPORT

Anthony Gasbarro, Technical Program Chair
Automotive Session, ANTEC® 2015

Hello, I have the pleasure of being the Technical Program Chair for the Automotive Division at SPE's Annual Technical Conference (ANTEC®) for next year (2015).

ANTEC is the plastics industry's largest technical conference held in North America. There are typically 2,500 attendees, and approximately 500 technical papers are presented. It's a great opportunity to learn about areas of the plastics industry to which we may not have regular exposure. I know that I always leave ANTEC with new ideas on how to cross-pollinate technology from one industry segment to another.

Next year's ANTEC conference will be co-located during the Society of the Plastics Industry's (SPI's) National Plastics Exposition (NPE®) event held in Orlando, Florida from March 23-27, 2015. The joint event provides a very exciting chance for SPE to work cooperatively with other organizations that support the plastics industry in the U.S. to create maximum benefit for our members. You can learn more about NPE at www.npe.org and you can learn more about ANTEC at www.4spe.org/ANTEC .

SPE's Automotive sessions have been increasing in popularity over the last few years and I would certainly like to keep that momentum going in 2015. Last year we had two packed sessions with a total of 11 papers. For next year's event, I'm hoping to break into the "teens" so we need to have three instead of two sessions. DO YOU HAVE A NEW CONCEPT/IDEA THAT YOU WANT TO PRESENT?

We have yet to schedule an exact date or time for the Automotive session, as zthose details will be ironed out in the coming months as papers are reviewed. The initial deadline for complete paper submissions is September 30th. However, please contact me directly if you have an idea and need some extra time. We are also looking for a few good plenary speakers for the Automotive session. This is a great opportunity for you to showcase a broader range of technology that you are working on and an excellent opportunity to showcase yourself as an industry expert as well. Other options are open for presenting technology or speaking to the audience about a technology relating to plastics in the automotive field. If you have a tutorial-type presentation you would like to present, please let me know. This could be a great addition to our session.

I hope to see many of you at ANTEC in Orlando next year. It is sure to be a big crowd.

Please feel free to contact me if you have any questions or comments.

Thank You

Anthony Gasbarro

anthonygasbarro@yahoo.com

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March 23-25, 2015
Orange County Convention Center | Orlando, Florida USA

Society of Plastics Engineers will once again co-locate our world renowned technical conference, ANTEC®, with SPI's **NPE2015** at the Orange County Convention Center in Orlando, Florida USA.

The event takes place March 23-25, 2015 and we are calling for paper submissions in a wide variety of areas within the plastics industry.

Authors will submit a full paper, including abstracts. Abstracts are not submitted separately.

The format may be either technical or commercial; presentations may be at podium or as a poster. Authors will be notified of accept/reject by the notification deadline below.

For a full list of topics, links to hotels, registration and other conference information go to **www.antec.ws**

Online Submission Site

antec2015.abstractcentral.com

Deadlines:

Paper Submission:	September 30, 2014 - 5:00 pm EST
Notification:	November 6, 2014 - 5:00 pm EST

Questions? Contact us:

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SPE Automotive Innovation Awards Competition

by Jeffrey Helms

SPE Automotive Innovation Awards Program Chair

It's almost fall in the Northern Hemisphere and that means that shortly, nominations will be due for the ***44th-annual SPE Automotive Innovation Awards Competition***.

There's still time to get individual part as well as Vehicle Engineering Team Award (VETA) nominations in for this year's competition. Form must be eMailed in to Awards@SPEAutomotive.com by **September 12**. Requirements are listed on our website at http://speautomotive.com/inno, but the key criteria are that the part must appear on a ground-transport vehicle available for sale by November 1 of the year it's nominated, although it may have been launched earlier than that. Also, the OEM involved must approve submission of the part. After sending in nomination forms and shipping in parts for the actual judging event, teams work hard to polish their 5-minute presentations, which explain why each part is the year's most innovative use of plastics.

This year's competition categories include:

- Body Exterior
- Body Interior
- Chassis/Hardware
- Environmental
- Electrical Systems
- Materials
- Powertrain
- Process / Assembly / Enabling Technologies
- Safety

We also feature a Hall of Fame winner, which is part that has been in continuous use on automobiles for at least 15 years in one form or another and has been widely adopted across the industry. Our VETA award recognizes the teamwork of OEM and supply team that drives significant use of innovative plastics and composites content on a new passenger vehicle. And we honor the contributions of our annual Lifetime Achievement winner, an award that recognizes the technical achievements of individuals whose work – in research, design, and/or engineering, etc. – has led to significant integration of polymeric materials on passenger vehicles.

First round of judging for this year's parts competition takes place on **October 2 and 3, 2014**.

Nominations that survive two grueling days of judging are considered *category finalists* and will advance to the Blue Ribbon Judging round on **October 13, 2014**. During that day, a winner in each category will be selected by our panel of retired chief engineers, auto-industry insiders, and active members of the automotive and plastics trade press. And one category winner also will be selected as the **2014 Grand Award winner**, judged to be the year's *Most Innovative Use of Plastics* in an automotive part.

Category and Grand Award, as well as Hall of Fame and Lifetime Achievement winners will be announced to the public during our 44th ***SPE Automotive Innovation Awards Gala*** on **November 12, 2014** at Burton Manor in Livonia, Michigan. We hope to see many of you at this year's program, which always is a fun evening that celebrates the innovation and teamwork that drive automotive plastics technology.

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End-to-End FE Based Homogenization of Woven Composites

Maxime A. Melchior,
Marc Duflot,
Jean-Sébastien Gerard,
Laurent Adam,
Roger Assaker

e-Xstream engineering, an MSC Software Company

Abstract

Woven composites are represented by interlacing yarns impregnated by a resin matrix. Yarns are made of a resin matrix reinforced by continuous fibers. Homogenization of woven composites therefore requires two levels of homogenization, the one of the yarn and the one of the ply. Finite element (FE) based homogenization at the ply level can be combined with mean-field homogenization at the yarn to predict the mechanical behavior of a single ply. The main difficulty of this approach lies in the generation of representative volume element (RVE) of a single ply.

An end-to-end FE based homogenization of woven composites was developed in Digimat®. The developed set of tools allows running finite element simulations on single ply woven RVE with the use of mean-field homogenization at the yarn level. Generated RVEs are meshed with voxels to avoid meshing troubles in resin rich pockets between yarns or close to yarn crossings. The local fiber orientation used in the yarn homogenization is function of the yarn curvature. A fully analytical framework based on mean-field homogenization has also been developed. The particularity of this framework is that it takes yarn curvature into account.

The developed tools will be presented and the FE based and mean-field homogenization predictions of linear properties will be compared to experimental measurements on plain weave and 5HS woven composites

Dr. Maxime A. Melchior was lead author (along with Marc Duflot, Jean-Sébastien Gerard, Laurent Adam, and Roger Assaker all from e-Xstream engineering) on a paper entitled *End-to-End FE-based Homogenization of Woven Composites*, which will be presented by e-Xstream colleague, Dustin Souza on September 9 from 2:00-2:30 p.m. at the SPE ACCE. The paper received the highest average rating among 83 contenders during peer review and was named a 2014 ***Dr. Jackie Rehkopf SPE ACCE Best Paper Award*** winner.

Melchior joined e-Xstream engineering in 2011 and is currently involved in all of the company's initiatives involving the modeling of woven fabric reinforcements for composites. He received a Ph.D. in Applied Mechanics in 2009 from the Université catholique de Louvain (UCL). Melchior also did post-doctoral research at UCL on modeling the non-linear behavior of woven composites. He has authored or co-authored seven papers to date.

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Background and Motivation

The large amount of woven designs is still found where tailor made, high-end solutions are needed and a costly solution is acceptable. The applications cover the Aerospace, Automotive (racing), Marine, wind technology and sport equipment markets. The overall objective is to use light-weight materials with the best stiffness and strength properties possible.

Woven composites are typically draped onto more or less complex surfaces to produce structural parts. The draping process can have significant impact on local warp and weft angles which leads to a local variation of effective material properties. Understanding the connection between the warp / weft microstructure, the resulting material properties and finally their influence on the part performance is crucial knowledge in the design process of woven composite structure.

A key challenge in the predictions of the woven behavior is the modeling of the mechanical behavior of a single ply. The purpose of this paper is to illustrate our ability to predict the linear behavior of single ply of woven through two different homogenization methods. This paper presents our end-to-end FE based homogenization and our mean-field homogenization for woven, braided and 2.5D woven. Comparison is made with experimental results for three different descriptions of woven.

FE based homogenization of woven

End-to-end solution

A complete end-to-end solution has been implemented in Digimat®. It allows performing all the different steps needed to obtain a complete FE analysis, starting from the material data available in the datasheet of the considered woven fabric. Those steps are:

- Mean-field homogenization of the yarns
- Generation of a geometry of a unit cell
- Generation of a RVE
- Voxelisation
- FE model definition and application of periodic boundary conditions
- Solving the FE analysis
- Post-processing the outputs of the FE analysis.

Generation of the geometry of woven, braided and 2.5D woven

Based on the description of the woven (weave pattern, yarn cross section dimension, yarn density in the woven), a geometrical model of each yarn is built [1]. Those geometries are then assembled to create a unit cell (Figure 1). This unit cell is in turn adjusted in order to create a parallelipipedic RVE out of it. This RVE will then be meshed and used for the FE analysis.

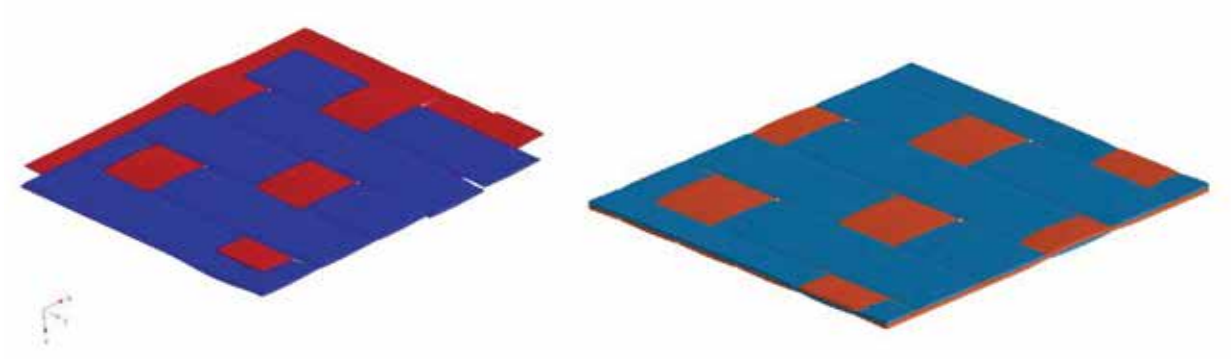

Figure 1:Satin 5HS unit cell (left) and parallelipedic RVE (right)

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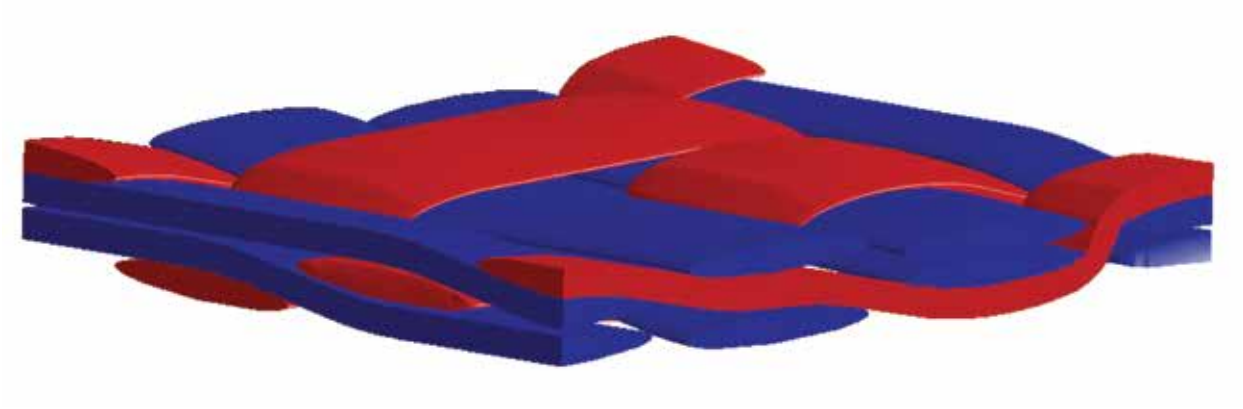

Figure 2: 2.5 D Woven

Voxelisation

The geometry is discretized with a regular pattern of 8-node brick finite elements. This pattern is known as a voxel mesh (volume and pixel). Each element is assigned to the material of the phase where its center is located: either in the matrix material or in the homogenized yarn material. In the latter case, the local orientation is mapped from the geometry to the yarn element. Such a voxel mesh is illustrated on Figure 3, where the matrix elements are hidden.

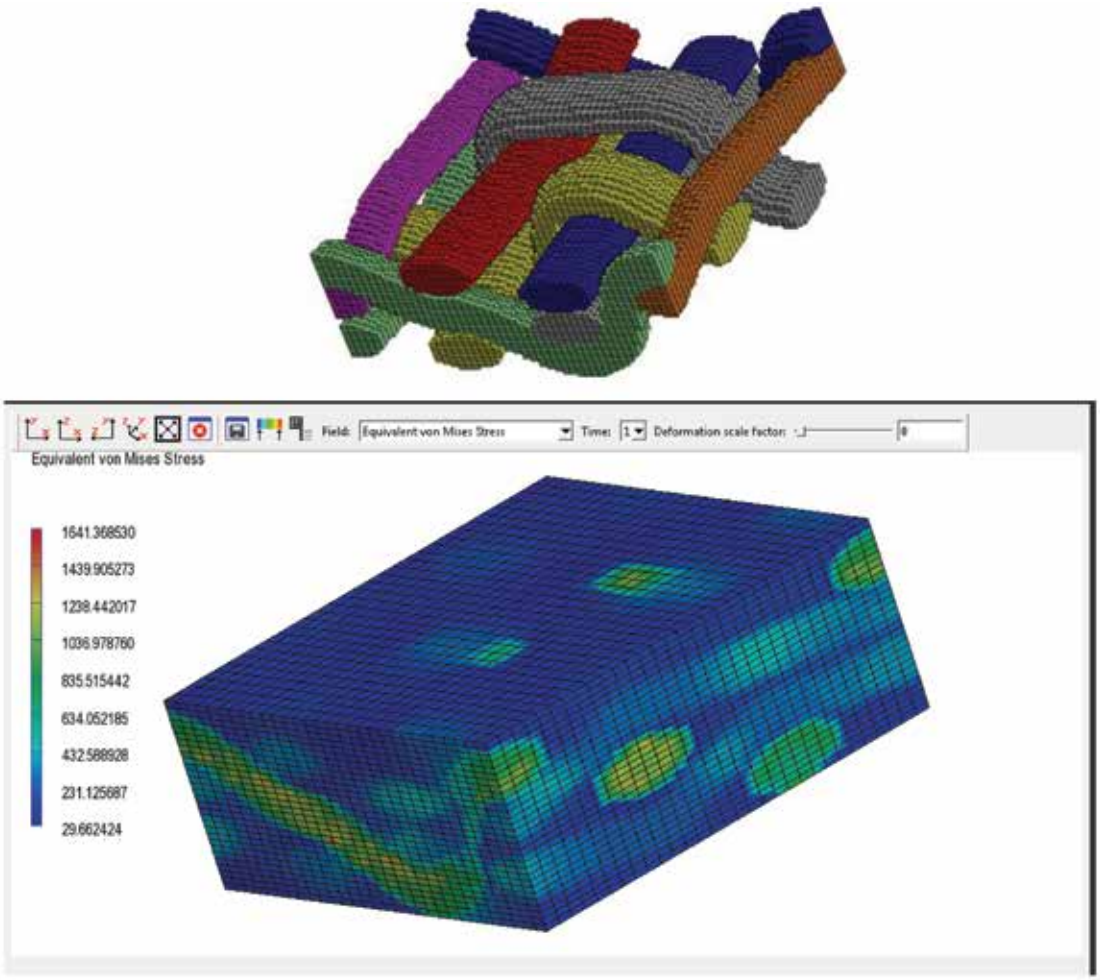

Figure 3: Voxel mesh of 2.5D woven yarn (top) and visualization of the results (bottom).

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In a voxel mesh, the boundary between the matrix element set and the yarn element set is a patch of rectangular facets that are parallel to one of the RVE faces. It may then be regarded as a less accurate approximation to the RVE inner surfaces than the one that would be obtained with a usual tetrahedral mesh generator with nodes exactly on the surfaces. Still, our approach is more robust than that alternative which leads to badly-shaped tetrahedral elements in areas between yarns or close to yarn crossings.

Moreover, the resulting finite element stiffness matrix has a smaller bandwidth and a better conditioning number than with a conventional mesh generator. The linear systems to be solved are well suited to iterative solvers, which we found to be particularly computationally efficient in this work. Consequently, models with small element edges, which represent the geometry sufficiently well, may be solved in a moderate CPU time.

Mean-field homogenization of woven

Mean-Field Homogenization Theory

Composites are by definition a combination of two or more constituents to obtain an improved material in comparison to the base constituents. As composite properties depend on the material microstructure including fiber amount and orientation, they are adequately modeled from micromechanics. In particular, mean-field homogenization combines the properties of the underlying constituents of a multi-phase material so that the original heterogeneous material is represented by an equivalent homogeneous one. Implemented in the Digimat software [2], this technology has proven effective for a broad range of materials.

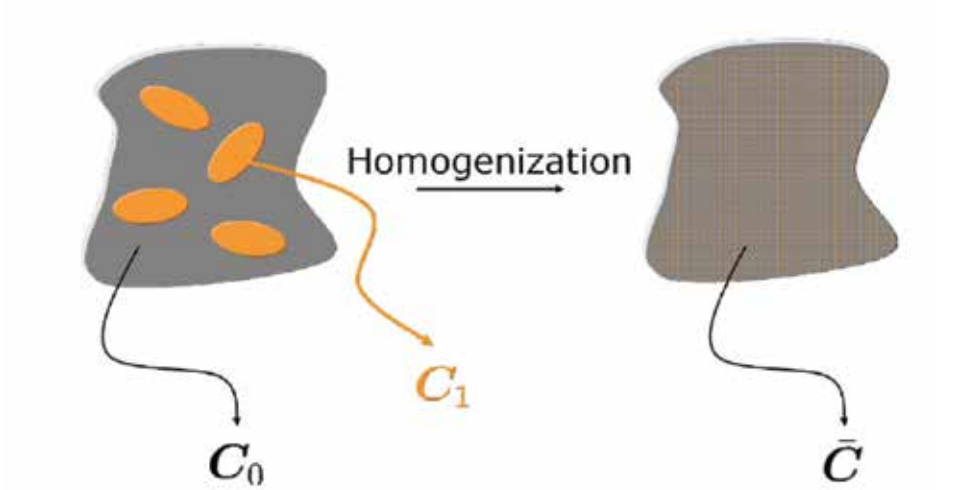

Figure 4: Heterogeneous material (left) from which its equivalent stiffness $\bar{C}$s computed from homogenization.

Application to woven

Woven composites rely on a two-step homogenization scheme. The first step consists in the homogenization of the local behavior of the yarn. The latter is modeled as a UD composite. The second step consists in the homogenization of the ply. The latter is described as a matrix reinforced by a large number of inclusions. The orientation, volume fraction and aspect ratio of these inclusions (Figure 5) are computed from the geometry and orientation of the yarn cross sections [1]. Therefore, the set of inclusions takes the yarn waviness into account. A current assumption of our model is that inclusions are represented by a spheroid instead of using an ellipsoid.

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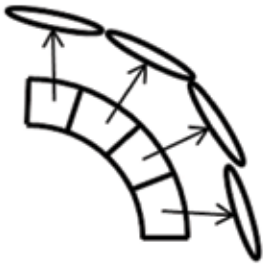

Figure 5: From the yarn cross-sections to spheroidal inclusions

Our current modeling for woven is limited to the elastic behavior.

Validation of both homogenization procedures

The FE and mean-field homogenizations of woven have been validated on three different types of woven: a balanced plain weave, an unbalanced plain weave and a 5HS satin. For each simulation 3D periodic boundary conditions and the Marc iterative solver are used.

The balanced plain weave glass/epoxy material data come from Lomov [3]. Our predictions with FE homogenization and voxel mesh and with mean field homogenization are compared to experimental data and the FE predictions with conformal mesh obtained by Lomov (Table 1). The yarn width-to-height ratio is equal to 17. The mesh consists of 50*50*20 voxels (Figure 6).

Table 1: Elastic constants of a balanced plain weave glass/epoxy material: experimental measurements and predictions.

	Experimental	Lomov	Digimat-MF	Digimat-FE
E11 (GPa)	26±1.5	25.2	23.94	23.5
E22 (GPa)	26±1.5	25.2	23.94	23.2
E33 (GPa)	NA	8.55	8.54	9.14
G12 (GPa)	NA	4.5	3.1	3.82
Nu12	0.264±0.148	0.128	0.134	0.123
Nu13	NA	0.402	0.43	0.383

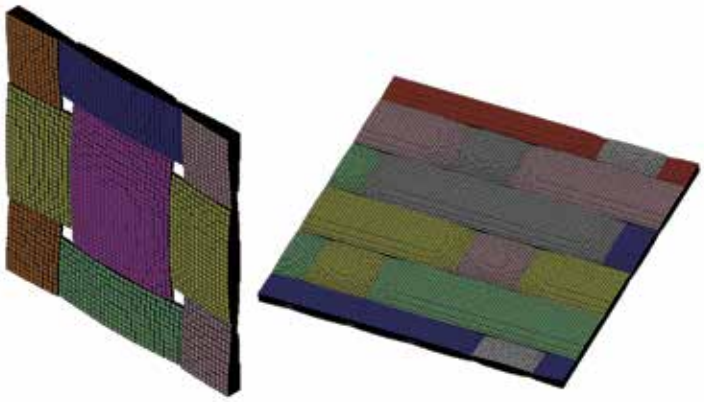

Figure 6: Voxel mesh used for the balanced plain weave glass/epoxy material and the balanced 5HS T-300 carbon/PPS material.

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Predictions obtained with our two methods of homogenization are close to the experimental measurements and to the predictions of Lomov. The larger discrepancy is observed on the shear modulus predicted by mean-field homogenization. Four simulations have been required to compute these properties. They took altogether a total computation time of 88secs.

The unbalanced plain weave glass/PPS material data come from Angioni [4]. The mesh consists also of 50*50*20 voxels. The ratio between the warp and the weft width is 0.91. The yarn width-to-height ratio is equal to 19. Our predictions with FE homogenization and voxel mesh and with mean field homogenization are compared to experimental data (Table 2).

Table 2: Elastic constants of a unbalanced plain weave glass/PPS material: experimental measurements and predictions.

	Experimental	Digimat-MF	Digimat-FE
E11 (GPa)	24	24.8	22.5
E22 (GPa)	24	24.7	22.0
G12 (GPa)	4.7	4.6	3.97
Nu12	0.12	0.195	0.145

The balanced 5HS T-300 carbon/PPS material data come from Angioni [4]. The mesh consists in 100*100*20 voxels (Figure 6). The yarn width-to-height ratio is equal to 20. Our predictions with FE homogenization and voxel mesh and with mean field homogenization are compared to experimental data (Table 3).

Table 3: Elastic constants of a balanced 5HS T-300 carbon/PPS material: experimental measurements and predictions.

	Experimental	Digimat-MF	Digimat-FE
E11 (GPa)	84	74.3	70.11
E22 (GPa)	84	74.3	68.52
G12 (GPa)	4.1	5.7	5.755
Nu12	0.02	0.071	0.051

The balanced plain weave model has been used to perform a study over the computation time for the voxelisation and the iterative solver over increasing number of degree of freedom (Figure 7). Both evolve quasi linearly. Less than hundred seconds are needed to obtain results from an input file when hundred thousands of degrees of freedom are involved in the computation.

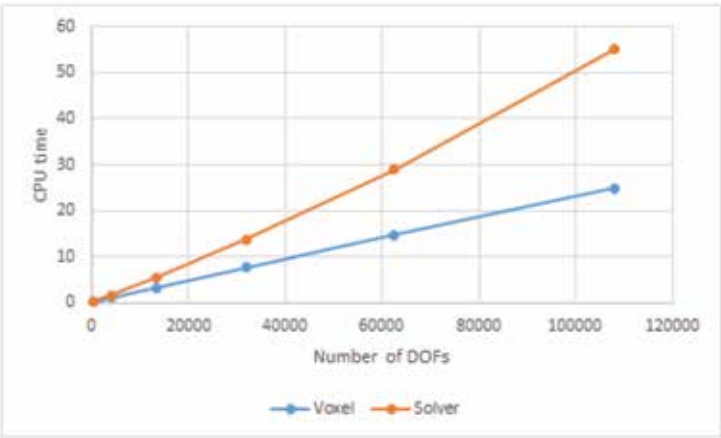

Figure 7: Evolution of the CPU time, in function of the number of degrees of freedom, for voxelisation and the iterative solver

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Perspectives

Our goal for the conference presentation is to use our woven modeling in the pole side impact of a composite beam (Figure 8). Others goals are to extend our mean-field homogenization method to non-linear method and to extend our approach to orthogonal 3D woven.

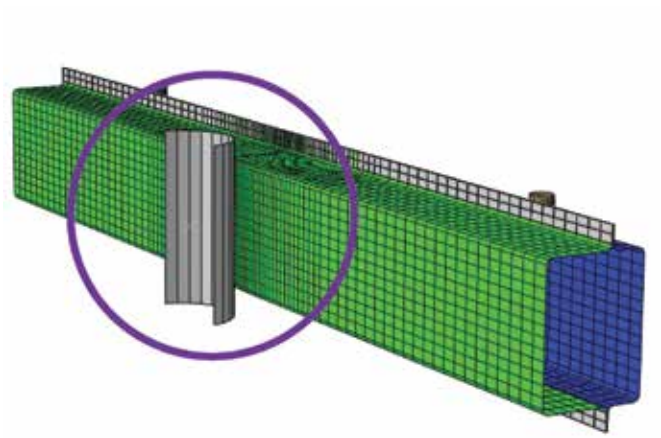


Figure 8: 3-point bending on a sub component to represent a typical pole side crash case [5].

Conclusions

Digimat® proposes an end-to end FE based homogenization of woven, braided and 2.5D woven composites. A single tool allows generating the geometry, the mesh, run the computation and post-processes the results from material data available in datasheets. The full determination of the elastic constants of a woven material can be obtained in less than 200secs when approximately hundred thousands of degrees of freedom are involved. The voxel mesh allows obtaining meshes for large width-to-height ratio of yarn cross-sections. The same material description can also be used in mean-field homogenization analysis. Predictions of elastic properties of both homogenization methods have been successfully validated against experimental measurements.

References

[1] Lomov S. V., Ivanov D. S., Verpoest I., Zako M., Kurashiki T., Nakai H., Hirosawa S., "Meso-FE modeling of textile composites: Road map, data flow and algorithms", Composites Science and Technology, 67, 1870-1891, 2007.

[2] e-Xstream engineering, "Digimat documentation Release 5.0.1," 2014.

[3] Lomov S. V., Ivanov D. S., Verpoest I., Bogdanovich A. E., Mungalov D., Zako M., Kurashiki T., Nakai H. "Predictive analyses and experimental validations of effective elastic properties of 2D and 3D woven composites", Proceedings of the 13th European Conference on Composite Materials (ECCM – 13), Stockholm, Sweden, June 2-5, 2008.

[4] Angioni S. L., Meo M., Foreman A., "A comparison of homogenization methods for 2-D woven composites". Composites Part B-Engineering, 42 (2), pp. 181-189, 2011.

[5] Bidaine B., Calmels S., "Progressive failure of CFRP coupons and automotive parts", submitted in Proceedings of SPE-ACCE 2014.

SECRETARY'S REPORT

SPE Automotive Division Board June 23, 2014 Minutes

Next BOD Meeting: Monday, August 11, 2014

ATTENDEES

Yvonne Merritt	Kevin Pageau	Suresh Shah	Maheen Khan
Teri Chouinard	Tom Pickett	Ron Price	Jacob Maclean
Fred Deans	Monica Prokopyshen	Ed Luibrand	Rose Petrella
Peggy Malnati	David Reed	Dawn Stephens	

Meeting was held at ACC in Troy, Michigan from 5:48 p.m. - 8:17 p.m. For further details, please refer to activity chair reports.

EDUCATION – Monica Prokopyshen

Fred Deans provided a summary of Detroit Section education activities and scholarships. The Detroit Section added the Mid-Michigan schools to the scope of their Plastivan® education program. Marjorie Weiner provided a summary of the 2013-2014 Plastivan visits sponsored by the SPE Automotive Division (SPEAD).

SOCIAL MEETING – Teri Chouinard

Thirty people signed up for the June social meeting. Prepaid gas cards are still available to raffle off for student attendees. The board of directors (BOD) discussed student use of Facebook® / Twitter® / and Instagram® for sharing networking experiences. Dawn and Jacob worked on methods to promote the June social event via these tools.

TREASURER'S REPORT – Dawn Stephens

A thorough, *pro-forma* budget was provided for review. The budget was based on analysis of current and historical accounts. To reduce complexity, the SPEAD migrated to cloud computing for handling accounts. There are 3 Quikbooks® seats that link to checking and PayPal® accounts. In the future, the PayPal account may no longer be required as SPE International assumes responsibility for event registrations.

Account balances as at June 23, 2014:

Checking	$249,700
Savings	$26,494
PayPal	$17,586
Total	$293,780

Includes advanced ACCE payments of $211,457

COUNCILOR'S REPORT FOR APRIL 27 MEETING – Tom Pickett

Refer to the June newsletter for a full ANTEC council meeting summary. The following highlights of the meeting were discussed at the June SPEAD BOD meeting. Outgoing President Jon Ratzlaff talked about the year's accomplishments, which included: 4 global conferences in 2013; the use of apps for conferences; the new SPE logo/graphic identity; new website; new user-friendly membership system; expanded services for TopCons; and the global parts competition at ANTEC.

Incoming President Vijay Boolani emphasized that decisions need to be made at lightening speed and stressed the need to accelerate by-law changes.

Dick Cameron's (treasurer) summary included:

Financials: Q1 positive $358,000, $100K above budget due to advanced ANTEC payments.

New website funding: SPE HQ is looking for advertising to cover site development costs of $125K; $45K in ads have already been sold. HQ wants to be the single-source website for the society and wants the independent section and division sites to migrate content. SPEAD's site costs currently are $15/month; migration to the HQ site would entail much higher usage costs and a migration cost potential of up to $35K-$55K, in addition to losses of flexibility and other benefits.

SPE overall membership continues to decline (unlike SPEAD's membership). HQ's membership focus will be redirected from direct mail to value provided through social networking and the online library. The virtual community launch is scheduled for November 2014.

ANTEC – Suresh Shah

Fourteen excellent papers were presented and there was good attendance.

MARCOM – Peggy Malnati

AutoEPCON: May 5, 2014. The ninth-annual conference set records for registered attendance (270) number of presentations, and sponsorship.

ACCE: Sept. 9-11, 2014. Current statistics include: 73 paying sponsors, 23 media/association partners, a sold-out exhibit space, 79 paper offers accepted, (2 more are expected from scholarship winners), and an executive panel organized by Jay Baron of Center for Automotive Research (CAR). A preliminary program will be published in July. SPE HQ will manage registration.

IAG: Nov. 12, 2014. Two press releases were issued. Norm Kakarala has been named the Lifetime Achievement Winner and the Hall of Fame (HOF) winner is the Blow Molded, Thermoplastic CV/J Half Shaft Drive Axle Boot Seal.

SPE AD Online: January's web traffic (35,760 unique visits) was the highest January on record. May 2014's volume (39,674) exceeded May 2013's (38,786). August 2013 (55,163) retains the record for highest volume to date. The SPEAD doesn't pay for position. The blog has 1,044 followers and Twitter has 995.

SPEAD Newsletter: 900 newsletters were mailed in March. In addition, there were 3,500 downloads of the March issue.

The deadline for articles for the Sept. issue is Aug. 15. The Sept. newsletter introduces a new feature column: *OEM's Corner,* which will be by-lined by Peter Bejin from Ford.

SECRETARY'S REPORT

Continued from page 41

SPONSORSHIP – Teri Chouinard

There are 9 newsletter sponsorships totaling $32,700.

NEW BUSINESS/OTHER

- House Chair – Open Position
- Intersociety Chair – Open Position
- The storage unit is no longer required so it will be emptied and the account closed. Jeff Helms has access. Savings will be $215/month.
- There was a lengthy discussion over the decision of two Detroit Section board members to change long-standing policy and exclude SPEAD BOD members from complimentary AutoEPCON attendance, particularly as the event is a joint undertaking between the Detroit Section and the Automotive Division. This led to a discussion of another surprise change in policy by SPE International: charging ANTEC moderators attendance fees; particularly irksome were fees charged moderators on days they moderated.
- Peggy will follow-up on providing Marjorie Weiner a banner for Plastivan use: a $99 pop-up (2 minimum), with $144 artwork costs and a lifetime guarantee).
- The Fred Schwab archives need to be reviewed and digitized as appropriate. The required document retention periods for SPEAD tax records were reviewed with the tax attorney. It was determined that records from 2008 and earlier tax years need no longer be retained.
- SPE International's new website went live April 22nd. http://www.4spe.org/.

TREASURER'S REPORT

by Dawn Stephens

Current finances for the SPE Automotive Division remain healthy. As of August 11, 2014 we have $213,914.25 in checking, $27,425.22 in savings, and $24288.55 in PayPal®, for a total of $265,628.02 USD.

SECRETARY'S REPORT

SPE Automotive Division Board August 11, 2014 Minutes

Next BOD Meeting: Monday, September 29, 2014

ATTENDEES

Pete Bejin	Ed Luibrand	Tom Pickett	Dawn Stephens
Teri Chouinard*	Maheen Khan*	Ron Price	Steve VanLoozen
Fred Deans	Peggy Malnati	Monica Prokopyshen	
Jeff Helms	Al Murray	Suresh Shah	

* non-voting attendees

Meeting was held at the ACC in Troy, Michigan from 5:30 – 7:45 p.m.

EDUCATION – Monica Prokopyshen

The 2014-2015 SPE Automotive Division (SPEAD) PlastiVan® budget was approved. Fred Deans reported that the SPE Detroit Section PlastiVan budget was increased to $60,000 and scholarships were increased to $20,000. Sandra McLelland is education chair for the Detroit Section.

SOCIAL – Teri Chouinard

The next social event is scheduled for the first or second week of December, from 4:30 – 6:30 p.m., in Troy. The venue and date will be reported at the next board meeting. This will be an opportunity to meet the new members. Our golf outing is September 8 and is our fall social outing.

MEMBERSHIP – Steve VanLoozen

The OEM membership drive has resulted in membership applications from Fiat Chrysler (10), Hyundai-Kia (4), and General Motors (14). Elias Shakour will follow up with Nissan and Teri Chouinard will follow up with Toyota. Applications need to be completed and approved before the ACCE conference.

TREASURER'S REPORT – Dawn Stephens

A motion was passed to approve the budget as amended: pre-paid OEM memberships of $5,000, an increase of $1,050 for subscriptions (for budget vs. actual QuickBooks® licenses), and the line item title was changed from PlastiVan storage unit to PlastiVan. The decision to refund the SPE rebate was tabled for the time being.

There will be 2 separate accounts in QuickBooks: a **new** "company" for records beginning July 1, 2014 and the **old** account for records prior to this date. The new account aligns with the approved 2014-2015 budget.

Account balances as at August, 11, 2014

Checking	$213,914	
Savings	$27,425	
PayPal	$24,288	
Total	$265,628	Includes advanced ACCE payments of $211,457

COUNCILOR'S REPORT – Tom Pickett

The next council meeting is September 13 in New Orleans, Louisiana.

ANTEC – Anthony Gasbarro

Papers for next year's ANTEC are due September 30, 2014. ANTEC is being held with the National Plastics Exposition (NPE®) in Orlando, Florida in 2015.

MARCOM – Peggy Malnati

ACCE: Sept. 9-11, 2014: SPEAD BOD members are invited. The schedule is on the website. Signage this year is color coded to the rooms. The event app has been launched. There are 4 hours of tutorials. Bios and speaker photos are included in the proceedings. First and second place best papers have been determined. ACCE scholarships have attracted international students. This year's main ballroom signage is comprised of 3 large vertical banners each 5 ft wide x 14 ft long.

Innovation Awards: Nov. 12, 2014: Three press releases have been issued to date. The Hall of Fame (HOF) writeup, if available by the publication deadline, will be included in the September issue of *Automotive Plastics News*. The pre- and post-event ads are in the process of being resized for magazines. New judges Dr. David Cole and Mike Liedtke have joined the Blue Ribbon panel. The **nomination deadline is September 12, 2014**. Nominated parts must be in production by or before November 1, 2014 and be available for sale to the public.

SPEAD Online: Web traffic this year has been running behind 2013 rates, except for January 2014's (at 35,760 unique hits, the highest January on record) and May 2014's (at 39,674 the highest May on record.)

Automotive Plastics News: The cover story for the September issue is ACCE 2014 and will have a bonus distribution for ACCE attendees. There is one new column: *OEM Corner*. Authors for key columns are: Fred Deans (An Engineer's Life), Libby Berger, GM (Service through Science), Jan Schut, Plastics Engineering (Batter's Box), and Pete Bejin, Ford (OEM Corner).

SPONSORSHIP – Teri Chouinard

There currently are nine newsletter sponsorships totaling $32,700.

NEW BUSINESS/OTHER

Next meeting: Monday, September 29, 2014.

1. House Chair –position still open.
2. Intersociety Chair – position now filled by Maheen Khan.
3. Director Openings – 4 positions open through 2017.
3. Clean up of the storage unit has begun.
4. Increase funding of $1,000/issue ($4,000 total/yr) was proposed and approved for the newsletter.
5. Increased funding of $2,500 was proposed for the Membership budget.
6. A motion was proposed for $10,000 in seed money to establish a scholarship fund in Jackie Rehkopf's honor. Other organizations are interested in participating including: Oak Ridge National Laboratory, the Department of Energy, and SAE International. A subcommittee (Jeff, Peggy and Teri) was formed to investigate legal and other requirements for establishing an endowment.
7. BOD Attendance. Some meetings have had insufficient attendance for a voting quorum, hampering decision making. Steve will report back on bylaw requirements for voting at board meetings.
8. Each future meeting will begin with a budget review.

Introducing activeGate™

New Tool-Based Molding Technology from Synventive

New activeGate Technology from Synventive provides unprecedented control over the molding process and enables production of higher quality parts that were previously unattainable with traditional hot runner systems. activeGate employs position, pressure and temperature sensors within the hot runner and mold cavities to provide ***independent melt flow control at each individual gate!***

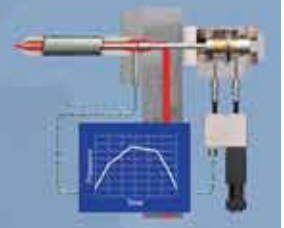
Benefits include:

- higher quality surface finishes
- higher production rates
- less scrap
- faster mold start-ups
- enables parts of complex geometries

The family of Synventive activeGate technologies includes:

Dynamic Feed®: activeGate Injection Pressure Control

Independent pressure control at each gate provides the ability to adjust flows differentially and more accurately

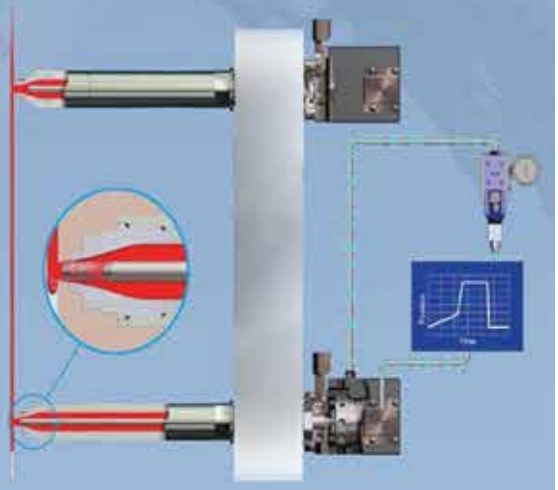


eGate®: activeGate Electronic Control

Highly precise control of pin movement and process repeatability

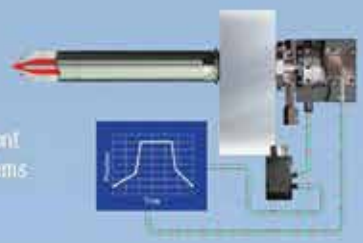
SynFlow®: activeGate 2-Stage Pin Control

Control of pin opening velocity solves surface defect issues



nuGate®: activeGate Pneumatic Control

Independent control of pin movement in commonly used pneumatic systems



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SOCIAL REPORT

Teri Chouinard,
SPE Automotive Div. Social Chair

Oakland University Students from REU Programs Enjoyed GM Heritage Center Tour

The June SPE Automotive Division (SPEAD) Social Event included a tour of the General Motors (GM) Heritage Center in Sterling Heights, Michigan with networking, pizza, and beverages following at Rosie O'Grady's. Ten students from the AERIM (Automotive and Energy Research and Industrial Mentorship) and IREECE (Interdisciplinary Research Experience in Electrical and Computer Engineering) REU (Research Experience for Undergraduates) programs at Oakland University, as well as 20 SPE members attended and enjoyed the event. The REUs at Oakland University are 10-week summer programs funded by the U.S. National Science Foundation and open to U.S. citizens nationwide. Students in attendance, who were part of these programs, were from Oakland University, University of Michigan, Wayne State University, Lawrence Technological University, Virginia Polytechnic Institute and State University (Virginia Tech), Georgia Institute of Technology, Morgan State University, University of Texas at Arlington, and University of Texas at Austin.

"I enjoyed looking at the history of cars, their evolution over time, and seeing how many of the different ideas reflected in the concept cars over the years actually came to life," explains Nevrus Kaja, a University of Michigan student who attended the tour as a participant in the IREECE REU at Oakland University.

After the tour, the students joined SPEAD members for dinner and discussion regarding the benefits of SPE membership and the students' research activities.

"It was great to have participation from students who appreciated the classic cars," noted Dave Reed, SPEAD board member, 2011 SPEAD Lifetime Achievement Award winner, and GM retired. "I also enjoyed hearing about their interesting research and how they are contributing to the advancement of technology today."

"This summer I was involved with research regarding hybrid quadcopters," adds Kaja. "The objective was to build a quadcopter that could both fly in the air and move under water."

It really was a great evening enjoying GM's finest classic cars with some of the best and brightest students from a variety of colleges and universities nationwide. As the purpose of SPEAD social events is to have fun and increase awareness of the benefits of SPE, including a focus on the younger generation, the event was successful. Hopefully the students who attended will join SPE and continue on their path toward success in the plastics industry.

 Continued from page 46

SPE Automotive Div. Golf Outing Monday, Sept. 8th, 2014

The 2014 SPE Automotive Div. Golf Outing returns to the Fieldstone Golf Club in Auburn Hills, Michigan on Sept. 8 — the day before the SPE ACCE. This gives ACCE attendees an opportunity to relax and get an early start on entertaining suppliers, customers, and prospects. The outing also is a nice occasion just to get out and enjoy good company and fresh air. To keep the event lively and interesting, there are contest holes including *longest drive, closest to the pin*, and *longest putt*. All contests include prizes, which add to the fun and excitement.

Fieldstone Golf Club is consistently hailed as one of the decade's top three public golf courses in Southeast Michigan. The facility features an exceptional variety of hole designs by the renowned architect, Arthur Hills, who meshes the diverse landscape and wetlands of Southeast Michigan with gently rolling fairways through majestic hardwoods.

Foursomes are only **$500**, which includes continental breakfast, lunch at the turn, and a nice buffet dinner. Contest hole sponsorships are only **$1,000**, including a foursome with breakfast, lunch, and dinner plus signage at the tee, keepsake flag signage at the hole, and additional recognition during the dinner as well as the opportunity to present the sponsored prize to the winning player.

Proceeds from the golf outing are used to support activities with SPE Student Chapters.

SPONSORS TO DATE INCLUDE:

DINNER SPONSOR	Plastic Engineering & Technical Services, Inc. (PETS)
LUNCH SPONSOR	Celanese
CONTEST HOLE SPONSOR – CLOSEST TO THE PIN	BASF
HOLE SPONSOR	Addcomp North America, Inc.
HOLE SPONSOR	Böhler-Uddeholm Corp.
HOLE SPONSOR	Chromaflo Technologies
HOLE SPONSOR	iD Additives, Inc.
HOLE SPONSOR	Plasan Carbon Composites
HOLE SPONSOR	PolyAd Services

New Members Holiday Mixer

A December holiday event hosted by the SPEAD board of directors to welcome new members is being planned. It will be in Troy, Michigan near I-75 and Big Beaver Road. Stay tuned to SPE eBlasts and the SPEAD website www.speautomotive.com for more details.

The purpose of SPEAD social events is to nurture networking, have fun, and build membership. If you have an idea for a social event, which may include a tour of your facility or other educational and fun ideas that will interest our membership and draw new members, please email teri@intuitgroup.com or call +1.810.797.7242.

MEMBERSHIP REPORT

Steve VanLoozen
SPE Automotive Div. Membership Chair

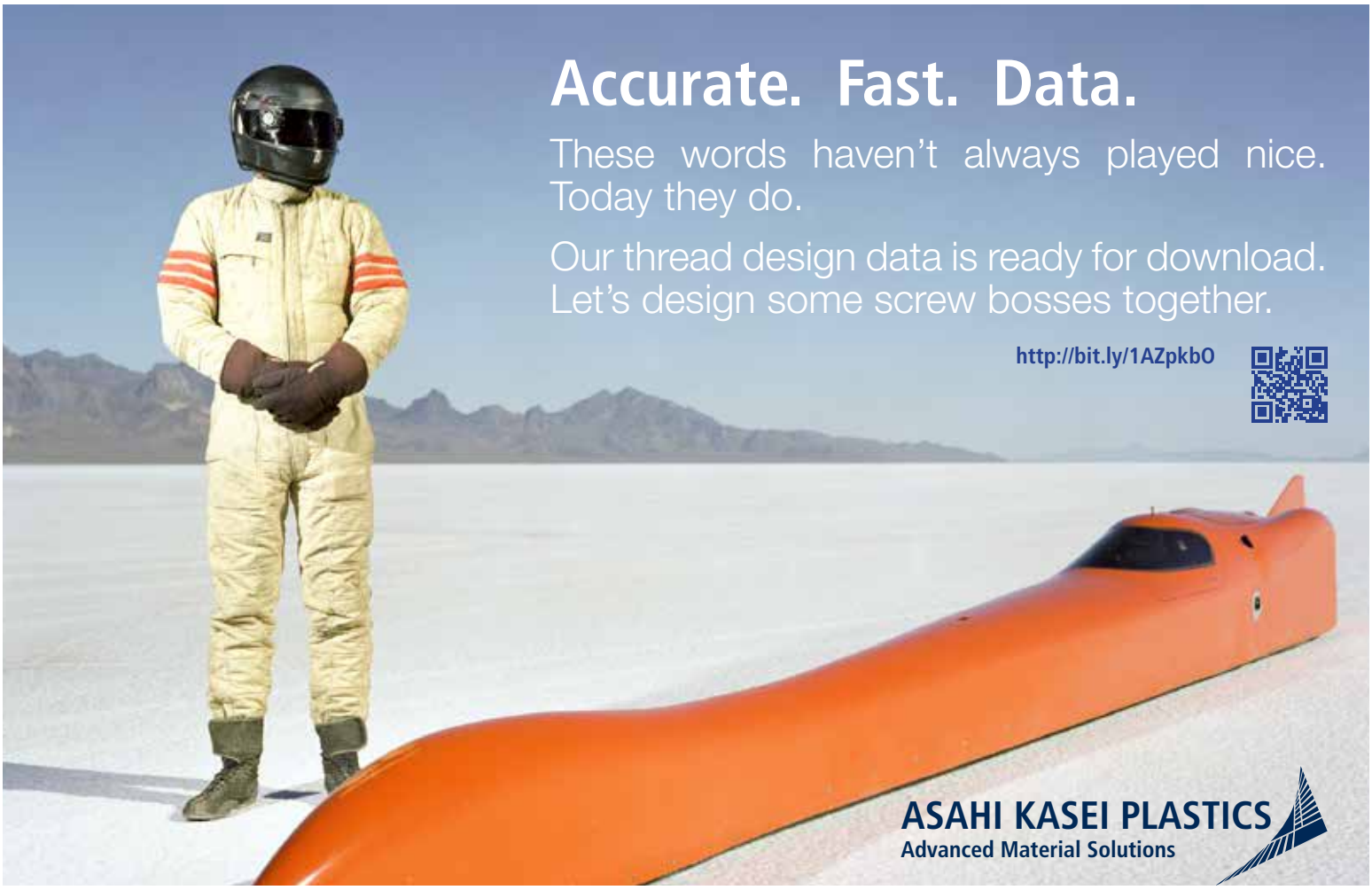
Our OEM membership drive has begun to gain traction in the past couple of months and we now have signed up over 20 new members from Ford Motor Co., Fiat Chrysler Automobiles, General Motors Co., and Hyundai KIA. Many of the new OEM members have backgrounds in materials engineering, but we also have added several new members that handle automotive component engineering. These new OEM members will help provide insights into where plastics will be required as the automotive industry moves toward lighter vehicles to meet much tougher U.S. Corporate Average Fuel Economy (CAFE) requirements in North America and carbon dioxide emissions mandates in the European Union.

Our hope and expectation is that these new OEM members will help us achieve higher attendance and participation at all of our annual events and will provide valuable "voice of the customer" feedback to our other SPE members on the supply side of this industry. With a healthy and active dialogue between all members of the automotive supply chain, we can work together to meet the needs of new platforms where weight and cost savings are key drivers to plastics growth.

I would personally like to thank each new member for joining SPE. Rest assured that our board will continue to work hard to deliver member value and promote the benefits of polymeric materials and our society within the car companies. We hope each new member has a positive experience and will recommend the benefits of membership to his/her peers so we have even more new members before the end of 2014.

Steven VanLoozen
SPE Automotive Division Membership Chair

Steven VanLoozen


Accurate. Fast. Data.
These words haven't always played nice. Today they do.
Our thread design data is ready for download. Let's design some screw bosses together.
http://bit.ly/1AZpkbO
ASAHI KASEI PLASTICS
Advanced Material Solutions

EDUCATION REPORT

by Margie Weiner &
Monica Prokopyshen

SPE® AUTOMOTIVE

The PlastiVan® Outreach Education Program is a hands-on science and technology program designed to excite middle school and high school students and the general public about the vast opportunities the plastics industry has to offer. The PlastiVan program travels to schools and companies educating people of all ages about the chemistry, history, processing, manufacturing, sustainability, and applications of polymeric materials. This enthusiastically received program is easily integrated into school curricula. The PlastiVan program provides sound science and educational programs that spark scientific curiosity in students while increasing their knowledge of the contribution plastics make to modern life, encouraging many students to seek careers in engineering or the sciences.

As a direct result of the PlastiVan program visiting Michigan high schools, Ferris State University (Big Rapids, Michigan) reports that it has the largest incoming class in the past 10 years, with over 70 students enrolled in the Plastics Engineering Technology Program. About 15% of these students currently have participated in at least one PlastiVan program and know about the industry as a direct result of this innovative educational outreach.

2013 - 2014 SCHOOL YEAR SUMMARY

Visits Sponsored by the SPE Automotive Division	28
Number of Students Educated	4,680
Total Cost	$30,350

SCHOOL-BY-SCHOOL SUMMARY

Severe winter weather in Michigan during the 2013-2014 academic year resulted in the cancellation of 6 program days, which mainly affected Lapeer schools.

A Dearborn alternative school for girls requested a Plastivan visit during their summer session.

Michigan Schools Visited During 2013-2014 Academic Year	Days Per School	No. of Student Participants
Boulan Park MS	2	280
Athens HS	1	150
Larson MS	2	300
Smith MS	1	240
Baker MS	2	450
St Clair MS	2	350
Explorathon™	1	90
Plymouth HS	2	350
Eisenhower HS	3	550
South Lyon HS	2	300
Hoover MS	2	350
West MS	2	350
Wayne Memorial HS	2	300
John Glenn HS	2	300
Meads Mill MS	2	320

LEGEND: MS = Middle School, HS = High School

Priority for the 2014-2015 academic year will be given to schools that experienced weather cancellations this year. The budget plan is $30 - $35 K for the next year and SPE is looking to add one or more teachers to meet increased demand for the Plastivan program.

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