



Automotive Plastics NEWS

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45th Annual



SPE® AUTOMOTIVE DIVISION NAMES WINNERS OF 46TH-ANNUAL AUTOMOTIVE INNOVATION AWARDS COMPETITION

The 46th-annual SPE Automotive Innovation Awards Competition and Gala is now behind us and was the largest event in recent memory, certainly the last decade. With 75 nominations this year and over 780 event registrations from across our automotive community, we saw an unprecedented level of participation and innovation from the Automotive market with representation from 10 automotive manufacturers around the world. I am certain that this will continue as we approach more challenging CAFÉ targets over the next few years which will drive increasing need for light weight vehicle systems and an increase of more efficient powertrains and electrification.

It is always very difficult to narrow down the list of 70+ quality submissions we receive each year to pick finalists and then category and the Grand Award winners. Many times the difference between being a finalist and winning a category is the difference of a vote or two. I think this shows how competitive the Automotive Innovation Awards Program is each year and should give satisfaction to all the nominees for a job well done with respect to commercializing innovative solutions in this industry. I would also like to especially recognize Professor Larry Drzal, University Distinguished Professor of Chemical Engineering and Director-Composite Materials and Structures Center at Michigan State University's College of Engineering as our most recent inductee for the Lifetime Achievement Award. Larry continues to be a force for innovation in the area of composites.

We will now turn to planning for next year's event, expanding our blue ribbon judging panel and continuing to strive for improvement in the execution of this program. If you attended our Awards Gala on November 9th and have suggestions on what we can do better, please don't hesitate to let us know. Email your comments to: feedback@speautomotive.com.

Jeff Helms

2016 SPE Automotive Innovation Awards Chair

Continued on Page 5

See this year's SPE Automotive Innovation Awards Competition winners at <http://speautomotive.com/inno> and <http://speautomotive.com/awa>.

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AUTOMOTIVE DIVISION MEETING SCHEDULE & SPECIAL EVENTS CALENDAR



SPE Auto. Div. Board Meeting Bastone Brewery, Royal Oak, MI	5:30 - 7:30 p.m. December 5, 2016
ANTEC Paper Deadline	January 13, 2017
SPE Auto. Div. Board Meeting American Chemistry Council - Auto. Ctr. Troy, MI USA	5:30 - 7:30 p.m. February 13, 2017
AutoEPCON Abstract Deadline	February 28, 2017
SPE Auto. Div. Board Meeting American Chemistry Council - Auto. Ctr. Troy, MI USA	5:30 - 7:30 p.m. April 17, 2017
12th-Annual AutoEPCON Detroit-Troy Marriott, Troy, MI USA	ALL DAY May 2, 2017
ANTEC 2017 Anaheim, CA	ALL DAY May 8-10, 2017
SPE Auto. Div. Board Meeting American Chemistry Council - Auto. Ctr. Troy, MI USA	5:30 - 7:30 p.m. June 12, 2017

Automotive Division Board of Directors meetings are open to all SPE members. All events are listed on our website at

<http://speautomotive.com/ec>

EEmail Matt Carroll at auto-div-chair@speautomotive.com for more information.

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CHAIR'S WELCOME

by Matt Carroll,
SPE Automotive Division Membership Chair



In the Autumn "back to school" season, which is arguably our busiest time of year in the SPE Automotive Division (SPE AD), major local happenings included:

- September 6th SPE AD Golf Outing
- September 6th-9th 16th Automotive Composites Conference and Expo (ACCE)
- October 2nd-5th 18th Annual TPO Automotive Engineered Polyolefins Conference
- November 9th 46th Annual Innovation Awards Gala (IAG)

SPE AD Records were set in many events, which is not surprising if one checks out the attached chart, from FRED (Federal Reserve Economic Data), which shows the monthly unit volume (millions) of light vehicle sales since 1976. We have been on quite a roll! The U.S. auto industry set a sales record in 2015 of **17.47** million light-vehicle sales according to the *Automotive News Data Center* and the current sales rate as of October 2016 is **17.91** million. The sustained surge in the North American automotive industry since the recession of 2008 surely has to help all industries in the Motor City and environs. If the surge is over, as most suspect, let's hope that we at least have a long and healthy, high plateau.



One *SPE AD Record* that is probably related to the good economy occurred at the Golf Outing, held at Fieldstone GC in Auburn Hills. More sponsors and funds were raised for SPE Student Chapters and scholarships than ever before. This course provided a fun challenge as even the white tees, though short at 5891 yards, are relatively tough with a slope of 133. However, not every *SPE AD Record* this year is related to the economy. Congratulations go to the record-setting First Place Team from M. Holland who shot a 55 (17 under par — whhaat???) and also to the Second Place Team from PETS who shot a very good (but at least more sane) 61, and finally to the Putting Contest Winning Team from BASF.

The golf was immediately followed by the ACCE which was a huge success again this year. There were 908 registered attendees from 34 states and 16 countries. The venue was the spacious Novi Suburban Collection Showcase. While some of us were golfing, 51 attended the "sold out" tour on September 6th to BASF. Heavy lifting for this event was accomplished by the entire SPE Composites Division Board and as well by our own Peggy Malnati, Bonnie Bennyhoff, Fred Deans, Teri Chouinard and many others.

Welcome

The TPO Conference was also a big hit! *SPE Records* were set in

- attendance (more than 900),
- size of the technical program (over 70 presentations),
- largest exhibition (over 80 exhibitors),
- and not to mention a 72 page proceedings guide

Great job by the Detroit Section team led by Dr. Sassan Tarahomi and David Okonski. The ambitious program started with two Sunday afternoon tutorials and I was pleasantly surprised to attend and find a full conference room of interested plastics professionals. The next three days were packed full of five excellent keynote speeches and three concurrent technical sessions, culminating in the Wednesday Harbour report. Three evening receptions were also featured, which reminds me of the old joke about mullet haircuts: all business in the front, party in the back!

Speaking of parties, to finish off the season, another top-notch Innovations Award Gala was held on November 9th at the Burton Manor in Livonia. A *SPE AD Record-setting* sponsorship supported the sell-out and purchase of 780 meals. More than 70 nominations were submitted from all OEMs and Tiers in the supply chain — another record! Jeff Helms again led the team and special kudos go out to Scott Marko of SPE HQ (and Bonnie) who helped to provide a flawless registration process this year.

As this busy and record-setting Autumn season winds down, let's all take some time to enjoy family and friends and buy a car or two. Seriously, though, I'd like to extend my wish for a blessed holiday season to everyone. May 2017 bring health, happiness, and enthusiasm to all!

Welcome



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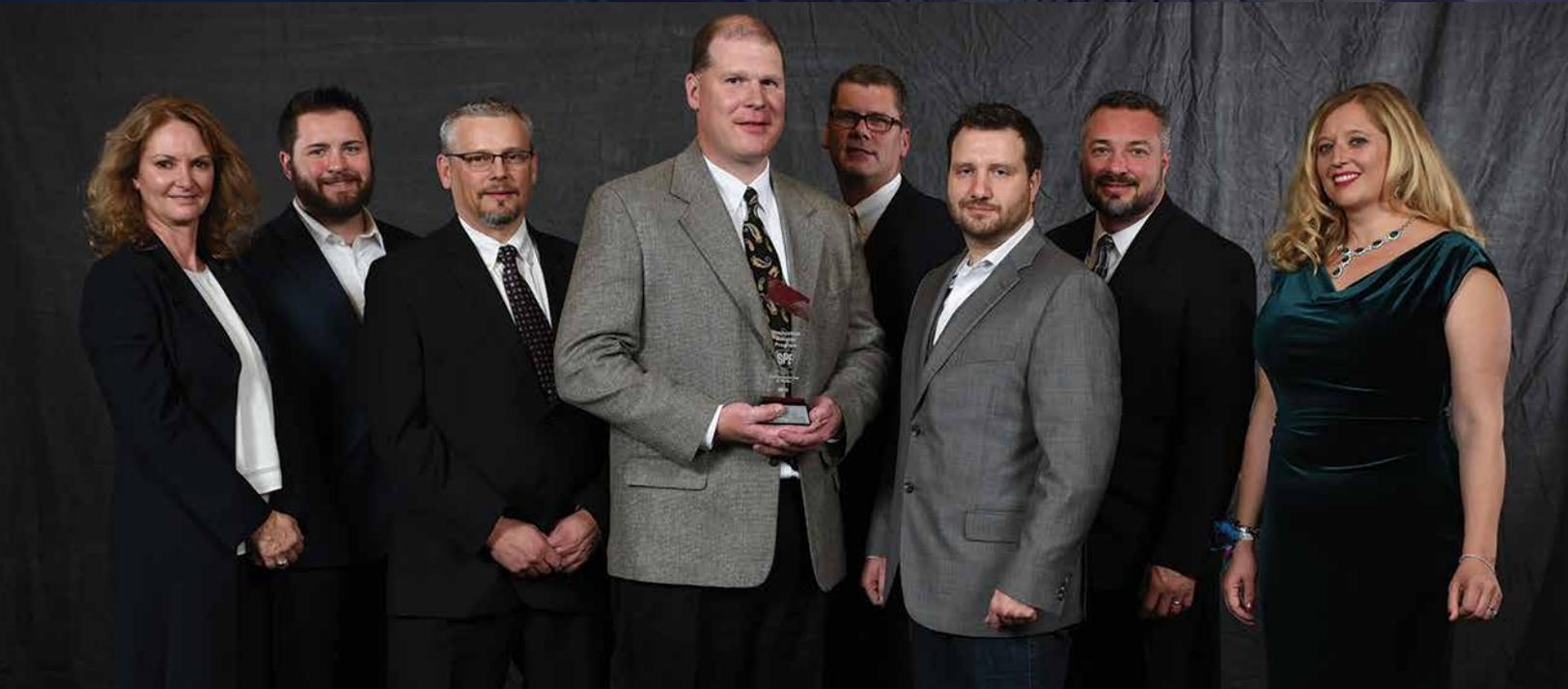
Our thread design data is ready for download. Let's design some screw bosses together.

<http://bit.ly/1AZpkbO>



ASAHI KASEI PLASTICS
Advanced Material Solutions

2016 SPE Automotive Division GRAND AWARD & CATEGORY WINNER: Body Interior



Composite Suspensions for Upper and Lower Seat Backs 2017 Ford Motor Co. Lincoln Continental



- System Supplier: Leggett & Platt Inc., Magna International
- Material Processor: Summit Plastic Molding, Century Plastics
- Material Supplier: BASF Corp., Advanced Composites, Inc., DuPont Automotive
- Material / Process: Ultramid B3ZG7 OSI 35% GR PA OSI; Ultramid B3EG3 15% GR PA; ADX 5017 18% talc-filled UV TPO; Delrin 100 POM / injection molding
- Tooling Supplier: Summit Plastic Molding, Mega Mold

Thanks to integrated composite designs, this “perfect position seat” suspension system delivers tuned suspension to optimize occupant comfort by cradling the upper back and providing side-torso support, which flexes to accommodate various occupant sizes. Special attachment features facilitate assembly and service time. The design also creates a robust dynamic crash-energy management system for rear-impact protection. Molded-in-color is used for A surfaces and craftsmanship. The system, for which 83 patents have been filed, reduces total seat weight by 8% and cost by 15% despite adding more features.

Category Winner: Aftermarket



Carbon Fiber Composite Spoiler

- OEM Make & Model: 2016 General Motors Co. Chevrolet Corvette
- System Supplier: deBotech, Inc.
- Material Processor: deBotech, Inc.
- Material Supplier: Solvay
- Material / Process: Solvay MTM57 epoxy / autoclave cure
- Tooling Supplier: deBotech, Inc.

This 1-piece aftermarket epoxy/carbon fiber spoiler provides a premium carbon composite appearance and enables the same aerodynamic performance as production 3-piece spoilers with different aero variants while also reducing mass by 40%. The spoiler's unique design and proprietary tooling combines solid wickerbills and an open cavity blade plus integral threaded inserts to facilitate manufacturing and assembly. The 1-piece construction offers a cleaner appearance due to reduction of fasteners. The spoiler is offered in both clearcoat with exposed weave and painted in carbon flash metallic paint.

Category Winner: Body Exterior



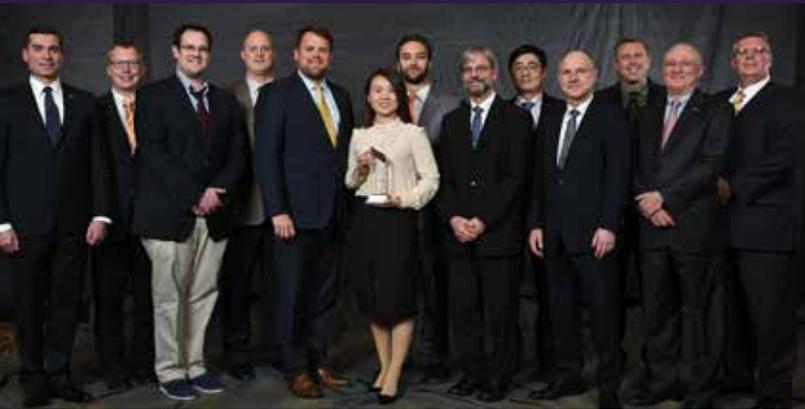
Structural Front End Module with Active Grille Shutter

- OEM Make & Model: 2016 Ford Motor Co. Ford Super Duty
- System Supplier: Shape Corp.
- Material Processor: Shape Corp.
- Material Supplier: Celanese Corp.
- Material / Process: Celstran GF40-20 40% GR LFT-PP / injection molding
- Tooling Supplier: Not available

This all-composite design without metallic reinforcement is the first AGS-capable, injection-molded PP-LFT FEM bolster used on a heavy-duty pickup platform. Replacing steel and plastic/metal hybrids at a 3 lb/1.4 kg and \$3 USD savings/vehicle, the design offers parts consolidation with locating features that aid fit & finish, improves airflow, while meeting structural requirements for part deflections of <1mm on this 8,500 lb/3,856 kg class vehicle.



Category Winner: Chassis & Hardware



Strut Mount

OEM Make & Model:	2016 General Motors Co. Cadillac CT6
System Supplier:	ContiTech North America, Inc.
Material Processor:	ContiTech North America, Inc.
Material Supplier:	BASF Corp.
Material / Process:	Ultramid A3WG10CR 50% GR-PA 6/6 / injection molding
Tooling Supplier:	Not available

This is the first use of a glass-reinforced PA material for strut-mount housings on all 4 corners of a vehicle and the first application of polyamide housings on the front and rear suspension systems. The injection molded parts integrate common components for both front and rear mounts, and employ a special thread assembly method with a locking feature. They reduce mass 30% vs. typical steel and aluminum parts and reduce noise transmission through the suspension system. Thanks to modular assembly, the design also offers greater tuning flexibility.



Category Winner: Environmental



Closed-Loop Recycling of Bottles

OEM Make & Model:	2016 General Motors Co. Chevrolet Equinox, GMC Terrain
System Supplier:	Exo-s
Material Processor:	Rogers Foam Co., Palmetto Synthetics LLC Unifi Manufacturing Inc.
Material Supplier:	Wm. T. Burnett & Co.
Material / Process:	Polyester
Tooling Supplier:	Not available

This innovative, multi-stakeholder, cost-neutral recycling project protects the environment, grows local economies, creates jobs, and helps people in a sustainable manner. Water bottles collected at GM operations and from the Flint, Michigan area are directed into a supply chain that recycles the material into nonwoven fleece for specific applications including engine manifold cover insulation, insulation for coats that convert to sleeping bags for the homeless and are made by formerly homeless women as part of a jobs program, and air filters that purify the air at numerous GM and other manufacturing operations. Already 3.5-million water bottles have been repurposed.



Category Winner: Materials



Category Winner: Powertrain



Vacuum Brake Tubes

OEM Make & Model:	2016 General Motors Co. Chevrolet Silverado & GMC Sierra
System Supplier:	Cooper Standard
Material Processor:	Cooper Standard
Material Supplier:	DSM Engineering Plastics
Material / Process:	Arnitel CM622 TPC-ET / extrusion & 3D post-forming
Tooling Supplier:	Not available

A high-performance thermoplastic was needed for vacuum brake tubing to replace reinforced rubber. It needed broad temperature performance (-40-150C), chemical resistance, burst strength to 60 bar min. and flexural strength to 50 N min. It also had to resist vacuum collapse after 2 hr @ 150C and provide impact retention after 336 hr @ 150C. The design was changed to use a smaller diameter, thinner wall to simplify engine/undercarriage routing and eliminate heat shields plus allow quick connects. A TPC-ET elastomer with high thermal oxidative stability was developed. It is 30% lighter, less costly, and eliminates brackets.

Air Intake Manifold

OEM Make & Model:	2015 Volkswagen AG EA21 Engine 1.6L engines
System Supplier:	Hua Tao Ltd.
Material Processor:	Hua Tao Ltd.
Material Supplier:	SABIC
Material / Process:	SABIC G3135X PP / injection molding & vibration welding
Tooling Supplier:	Not available

This is the first air-intake manifold launched in China using 35% GR-PP to replace PA 6/6. The application provides 25-30% cost reduction and 15-20% molded-part weight reduction while retaining properties at high temperatures and improving weld strength, and NVH by 5 dB. Unique technology involving finer glass fibers and special sizing helps meet performance requirements. Parts are vibration welded.



Category Winner:
**Process / Assembly /
 Enabling Technologies**



Robotic Laser Cutting and Welding of TPO Fascia

- OEM Make & Model: 2017 General Motors Co. Chevrolet Camaro ZL1
- System Supplier: Magna Exteriors, Inc.
- Material Processor: Magna Exteriors, Inc. / DexSys
- Material Supplier: LyondellBasell
- Material / Process: Hifax TYC1168X TPO / injection molding + robotic laser cutting & welding
- Tooling Supplier: Jenoptik AG

A hydraulic punch and sonic welding operation was replaced by robotic laser cutting and welding of a Class A exterior fascia. Unlike other welding processes, it is not necessary to thicken wallstock in weld areas to prevent readthrough with robotic laser welding of brackets on the backside of the part, and that reduces weight slightly. It also eliminates the need for contoured horns and punches. Clean cuts can be made in 1 sec on the painted side of the part. The dual-function process provides greater flexibility between programs and reduces floor space and tooling costs.



Category Winner:
Safety



Seat Cushion Frame and Storage Door

- OEM Make & Model: 2016 Ford Motor Co. Ford Super Duty
- System Supplier: Royal Technologies Corp.
- Material Processor: Royal Technologies Corp.
- Material Supplier: Celanese Corp.
- Material / Process: Celstran GF40-20 LFT-PP / injection molding
- Tooling Supplier: Vortec Tooling Solutions, Inc.

For the first time, a polymer composite has replaced magnesium in a structural seat-cushion frame and under-seat storage lid for a front center 20% seat with integrated restraint system. The application is weight neutral and lower cost (~\$4 USD/unit), and satisfies all safety and crashworthiness requirements. Its flexible architecture allows for updates with future enhancements. Injection molded 40% LFT-PP is used to mold the frame, which also features an EPP ant submarine foam block and a lockable ergo-latch. The assembly represents a significant reduction in carbon footprint vs. magnesium and has yielded 2 awarded and 2 pending patents.



Category Winner: Hall of Fame



EDUCATION REPORT

by Monica Prokopyshen,
SPE Automotive Div.
Education Chair

STUDENTS SUPPORT THE INNOVATION AWARDS GALA

Once again this year, many students arrived early and, not only learned all about the latest automotive plastic innovations, but helped out with the Gala setup. The student sponsor was MEDC (Michigan Economic Development Corporation) and each student was provided a planet M lapel pin. The Planet M is the newest campaign to promote Michigan into the global center for mobility. More can be read here, if interested: <http://www.planetm.com/>

Here are the list of students from the four Universities that were represented.

Ferris State University

Laura Myers
Michele Ruppel
Lindsay Spencer
Blaise Burmania
Andy Martin
Hanna Clinard
Kaylyn Steele
Austin Adamczyk
Ferris State University Professor
- Robert Speirs

Michigan State University

Aaron Beavers
Alice Kilvington
Ray Szeto

Kettering University

Alex Kesek
Liz Lomheim
Dylan Hett
Forrest Baker
Adam Henry
Michael Murray
Nick Moll
Zac Coblentz

University of Michigan

Rachel Shifman
Bryce Kriegman

First Polycarbonate Instrument Panel

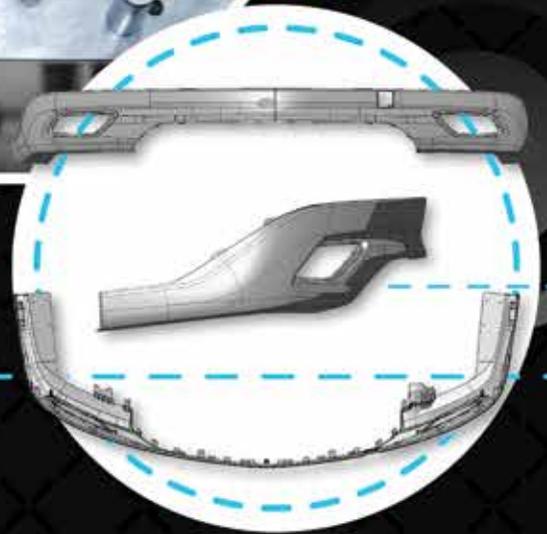
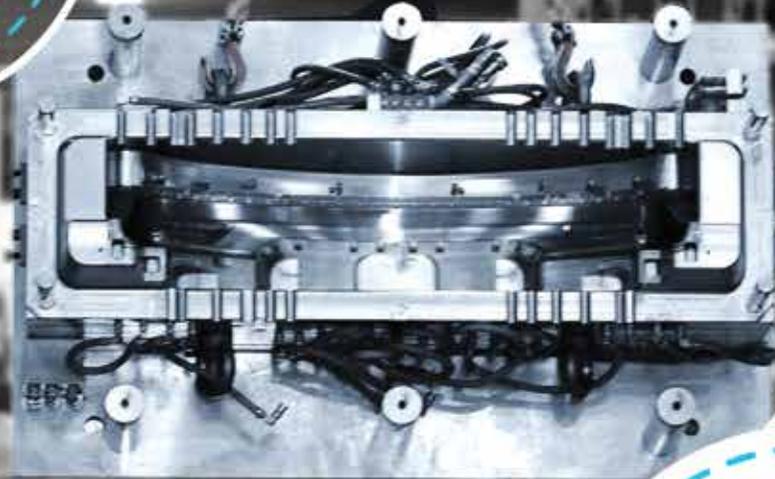
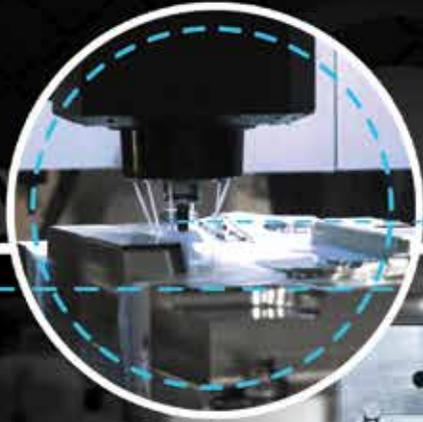
OEM Make & Model:	Ford Motor Co. 1977 Econoline Van
System Supplier:	Ford Saline / Faurecia Interior Systems
Material Processor:	Ford Saline / Faurecia Interior Systems
Material Supplier:	GE Plastics / SABIC
Material / Proess:	Lexan PC / Injection molding

The first use of polycarbonate (PC) to injection mold a hard (painted) instrument panel (IP) featured on the 1977 Econoline van is the 2016 Hall of Fame winner. PC and PC blends have been used to mold IP retainers, uppers, upper trim, lowers, and lower trim for both hard (painted) and soft (skin & foam) IP systems for the last 39 years. The application proliferated from commercial vans to pickups, passenger cars, and SUVs. To date an estimated 200-million IPs using 2-billion pounds/907,185 tonnes of PC or PC blends have been produced globally in the passenger vehicle market.



Special Kudos to *Crystal VanHouten, Teri Chouinard, Peggy Malnati, Gordie Miesel and Bonnie Bennyhoff* who helped coordinate the student attendance and activities!

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Treasurer's Report

BY BONNIE BENNYHOFF,
SPE AUTO. DIV. TREASURER

As of November 15 2016, the division's account balances were:

Checking:	\$409,073.40 USD
Savings:	\$ 27,449.94 USD
Total:	\$436,523.34 USD

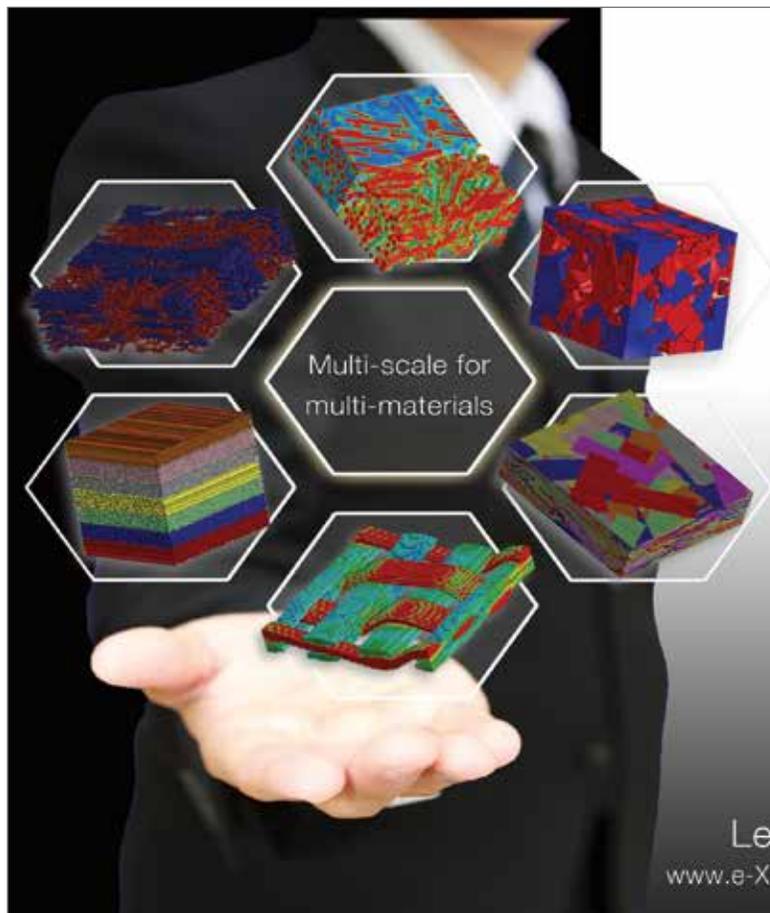
The Automotive Division completed its two largest annual events since the last newsletter was published and I'm happy to report they contributed positively to our bottom line, exceeding budget forecasts.

The Automotive Composites Conference & Exhibition (co-sponsored with the Composites Division) had 80 sponsors and attracted 908 participants. We were able to provide more than \$9300 in student scholarships and offered free SPE membership to all international students who participated. Additionally, both the Automotive and Composites Divisions each gave at least \$5000 to the Jackie Rehkopf Endowed Scholarship fund which awarded two \$5000 Best Paper Awards.



It's too soon to report on the financial success of the Innovation Awards Gala since not all bills have been received yet. But we sold out the venue, and our team did a great job of controlling expenses, so I can say with confidence there will be a surplus of funds to put to good use.

Speaking of good use – it's that time of year again when we sponsor the PlastiVan to visit local schools to teach students about plastics and careers in plastics. If you'd like to see the PlastiVan visit your school, or to learn more, please contact me at +1.248.244.8993, ext. 4, treasurer@speautomotive.com.



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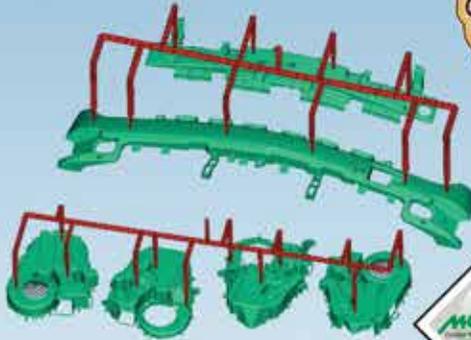
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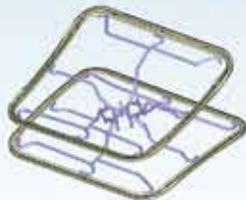
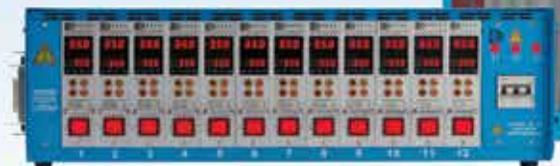
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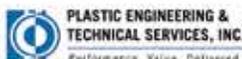
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MEMBERSHIP REPORT

Steven VanLoozen,
SPE Automotive Division
Membership Chair
BASF Corp.



The Automotive Division currently has 967 active members with 4 lapsed memberships and 23 new memberships in the September 2016. Membership is still one of the most critical keys to the long term viability of SPE and the Automotive Division. I will continue our focus on drawing new members from the OEMs and major Automotive Suppliers and we will be planning events for 2017 that we hope will help push our membership back well over 1,000.

We had another incredible Innovation Awards Gala on the evening of November 9. Congratulations to the winners and all that participated. It was a truly excellent evening and I would like to thank our members and the students that helped pull the event together. Our dedicated members make these events possible and we are always searching for new members to keep the enthusiasm and hard work going. With this I implore all our members reading this to encourage your colleagues and friends to join us in the Automotive Division of SPE and reap the rewards of membership. I do hope everyone has a truly blessed holiday season and we look forward to another great year in 2017.

Membership

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to the finalists and to those who partner with us to bring unique solutions to the Automotive Industry!

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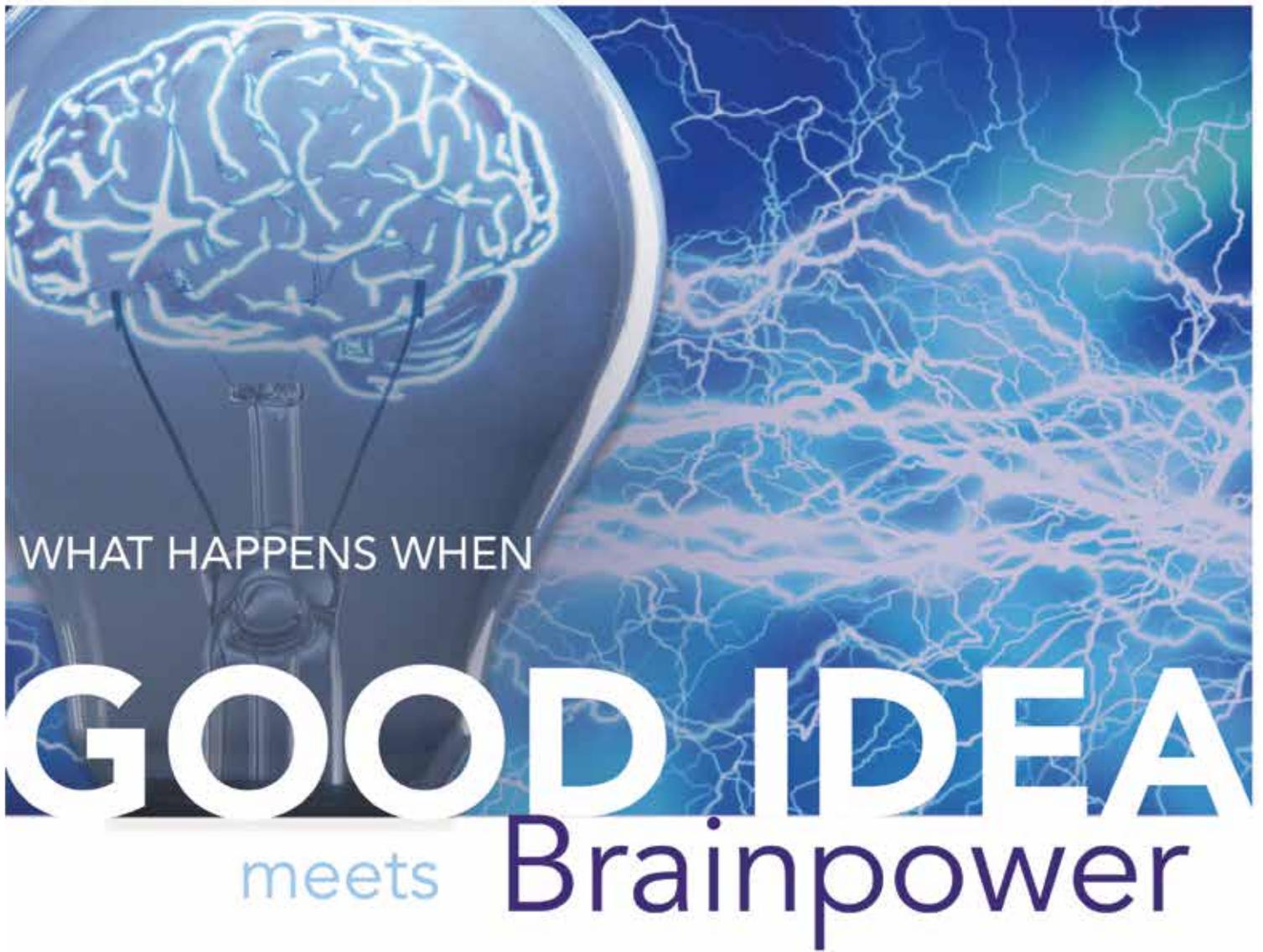


Dr. Lawrence T. Drzal, university distinguished Professor of Chemical Engineering and Director – Composite Materials and Structures Center at Michigan State University's College of Engineering (MSU, East Lansing, Mich., U.S.A.), has been named the 2016 **Lifetime Achievement Award** winner by the Automotive Division of the **Society of Plastics Engineers (SPE®)**. Drzal, the first academic winner of the award, is a composites expert who has specialized in surface and interfacial aspects of adhesively bonded joints plus the fiber / matrix interphase in composite materials and their processing; adhesion fundamentals; sustainable bio-based structural composite materials; and nanocomposite materials. During his career Drzal has given over 400 invited presentations at national and international conferences, published over 375 research papers, and has been awarded 35 patents.

Drzal credits his early engineering and co-op training coupled with his industrial and military service for his "problem-definition" approach to research, which has been characterized by observation of phenomena and identification of unresolved problems with common themes around technological advancement, sustainability, environmental friendliness, and benefit to society." As a result, Drzal says he always has had the desire to provide both practical knowledge and fundamental knowledge in each research area and the research project he and his students have undertaken.

He is a founding member of both the Adhesion Society and the American Society for Composites and has served as president (1998-1999) of the Adhesion Society. He has chaired the Gordon Conference on Adhesion and the Gordon Conference on Composites and has served in many other professional activities related to chemical engineering, composite materials, and adhesion. He served on the editorial board of journals in the adhesion and composite materials fields (Composites Part A: Applied Science and Manufacturing; Journal of Biobased Materials and Bioenergy; Carbon Letters; and Nanocomposites) and was associate editor of the Journal of Adhesion.

Drzal earned a B.S. degree in Chemical Engineering from University of Detroit and a Ph.D. in Chemical Engineering and Polymer Science from Case Western Reserve University. He joined MSU's College of Engineering as a professor of Chemical Engineering in 1985 and became director of the school's Composite Materials & Structures Center in 1986. A decade later, he became a university distinguished professor of Chemical Engineering & Materials Science.



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Scholarship Awards

SPE[®] Awards ACCE, Rehkopf Scholarships for 2016-2017 Academic Year

Winners of three annual *SPE ACCE scholarships* sponsored by the Michigan Economic Development Corp. (Lansing, Mich., U.S.A.) as well as two new *Dr. Jackie Rehkopf scholarships* from an endowed fund that has been set up to honor the long-time SPE ACCE committee member, SPE Automotive Division board member, and automotive composites researcher were honored during opening ceremonies at the 2016 SPE ACCE on Sept. 7th.

The two winners of the SPE ACCE graduate scholarships (\$2,000 USD each) were **Mr. Lu Wang** of *University of Maine-Orono* (Orono, Maine, U.S.A.) and **Mr. Srikanth Raviprasad** of *University of Illinois at Urbana-Champaign* (Champaign, Ill., U.S.A.). A third ACCE scholarship (also \$2,000 USD) for a student attending a university or college in the U.S. state of Michigan was won by **Ms. Mariana Batista** of *Michigan State University* (East Lansing, Mich., U.S.A.). The two Rehkopf scholarships (\$5,000 USD each) were won by **Mr. Sebastian Goris** of *University of Wisconsin-Madison* (Madison, Wisc., U.S.A.) and **Mr. Robert Hart** of *University of Iowa* (Iowa City, Iowa, U.S.A.). ACCE scholarship winners are required to present the results of their research at next year's SPE ACCE show, September 6-8, 2017; Rehkopf scholarship winners are required to either present the results of their research at next year's SPE ACCE or publish them in an SPE journal. Both scholarships are administered as part of the SPE Foundation[®] (Bethel, Conn., U.S.A.).

Lu Wang won his SPE ACCE graduate scholarship with the topic: *Cellulose Nanofibrils Reinforced Polypropylene by 3D Printing for Lightweighting*. About his project and its potential impact on the automotive composites industry, Wang said, "CNF [cellulose nanofibrils], a type of nano-scale cellulose fibers, have extraordinary potential to be used as a reinforcement in polymers. They are estimated to be as strong as steel, but five-times lighter and with stiffness equivalent to high-performance aramid fibers. Compared to other kinds of reinforcements, CNF has lower density, higher specific strength and modulus, lower cost, worldwide availability, recyclability, and biodegradability. On a related subject, 3D printing has been found to benefit the automobile industry, especially for prototyping design and testing. However, two obstacles exist for 3D printing some semi-crystalline polymers like polypropylene (PP). First, the PP molecule crystallizes during printing, which leads to residual stresses and warpage of the printed layers. Second, the mechanical properties of printed polymers are only 60-80% of their injection molded counterparts because the printing process generates many voids inside parts. Hence the two objectives of my research are to explore the use of CNF in 3D printed PP and to make printed PP parts equally strong as their injection molded counterparts."



Srikanth Raviprasad won his SPE ACCE graduate scholarship with the topic: *Novel Structure-Material System to Resist High Velocity Impacts*. Explaining the significance of his work on the automotive composites industry, Raviprasad said, "My aim is to elevate the current technology for sandwich structures by introducing a novel cellular architecture — triply periodic minimal surface (TPMS) — made of polymers (primarily polyamide) as the core material in order to improve the impact response and increase the energy absorption of composite sandwich structures. The sandwich panel's face sheets will be designed using glass-fiber laminates of different fiber-volume fractions, with its stacking and orientation criteria inspired by examples found in nature — like architectures of armadillo and stomatopod shells — to effectively transfer impact load across the surface rather than through the thickness of the structure. Results from both computations and physical experiments will be compared against those obtained from traditional aluminum-core sandwich structures used today to see if we can achieve a better material response with our novel technology. If we are successful, it could effectively lead to both lighter weight and lower cost components for rough-terrain vehicles that are prone to impact loads from ground, weather, and the other conditions."

Mariana Desirée Reale Batista won her SPE ACCE Michigan scholarship with the topic: *Hybrid Cellulose Composites: Lightweight Materials for Automotive Applications*. Describing the research she will do on this project, Batista says, "Lower weight, high strength, and high stiffness are often identified as desirable properties for parts used in both the aerospace and automotive fields. In order to achieve these engineering goals, meet the fuel economy and emissions mandates in many parts of the world, and contribute to global sustainable development, cellulose fibers have attracted considerable attention within the transportation industry. As a class of reinforcing agents for polymer composites, they have been widely studied because of their low cost, low density, high mechanical properties, and considerable environmental benefits. My proposed research is focused on development of hybrid composites combining cellulose fiber with glass fiber, carbon fiber, and talc in matrices of polypropylene or biobased polyamide, and on evaluating the mechanical and thermal properties of the resulting composites for automotive underhood and body interior applications. In this project I am investigating synergetic effects of combining various fibers, looking for the ideal concentration of each constituent, and also qualifying the fiber-matrix interphase. It is worth mentioning that hybrid composites reinforced exclusively with cellulose fibers are less frequently developed, but they also are potentially useful materials with respect to environmental concerns for automotive applications. The hybrid cellulose composites from this research may replace or reduce the use of synthetic fibers in many automotive applications leading to weight and cost savings. Therefore this new approach to the development of eco-friendly and lightweight composite materials should be beneficial to the transportation industry."

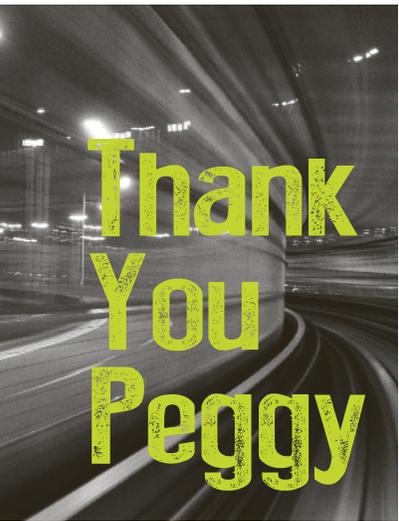


Sebastian Goris won his Rehkopf scholarship with the topic: *Experimental Evaluation and Numerical Simulation of the Process-Induced Fiber Configuration in LFT Injection Molding*. About his work and its potential impact on the automotive composites industry Goris says, "During moldfilling of LFT [long-fiber thermoplastic] materials, the fiber configuration significantly changes as reflected by fiber attrition, excessive fiber orientation, fiber jamming, and fiber-matrix separation. A major challenge in the field of LFT processing has been and remains the lack of availability of reliable measurement techniques to allow accurate fiber property measurements of sufficiently large samples in a timely manner. The goal of my research is to gain an in-depth understanding of the underlying physics behind fiber motion and the process-induced microstructure of the fibers. As one part of my research, I'm developing novel measurement concepts to evaluate the process-induced fiber microstructure to validate simulation results by using sophisticated techniques, including micro computed tomography. Additionally, I am working on new simulation approaches and models to better predict changes in fiber configuration during processing — in particular to control and predict the reduction of fiber length in LFT processing, which affects mechanical properties of the resultant part. As we develop expertise in measurement techniques and modeling approaches, we'll be able to apply them to study

the relationships between microstructural parameters and unsolved phenomena, such as fiber attrition and fiber agglomeration in injection molded parts. Eventually, the results of my work will translate into an improved understanding of the damage and motion of fibers during injection molding, which is necessary to fully exploit the lightweight advantages of LFT materials."

Robert Hart won his Rehkopf scholarship with the topic: *Multi-Physics Effects in Carbon Fiber Polymer Matrix Composites*. Discussing why his research will be of interest to those working in the transportation composites field, Hart notes that "My project will focus on developing theoretical models for designed optimal composite structures for multifunctional applications. I'll explore the use of new, advanced reinforcement media (e.g. carbon nanotubes, buckypaper, and graphene) that provide optimum combinations of electrical, thermal, and mechanical properties. My areas of interest include damage modeling and the influence of damage on the multi-physics response in advanced composites. This research should eventually lead to the development of "smart structures" with capabilities like real-time damage sensing that will be of interest to manufactures of aerospace as well as ground vehicles."





A FOND SENDOFF FOR PEGGY MALNATI, SPE Automotive Div. Communications Chair

Peggy Malnati will be retiring from our SPE Automotive Board at the end of the 2016 calendar year. She has been a **Board Director, Communications Chair, Webmaster, Newsletter Editor** and much more over the last fifteen year period, since November 2001.

Peggy has had something of a “love affair” with Composites, being a contributing editor for Composites World magazine for the last 11-1/2 years, as well as being a leader of the Automotive Composites Conference and Expo (ACCE), our event that is sponsored jointly with the Composites Division. With Peggy on the team, this event has continued to grow and become the largest conference in the world for automotive composites. Dr. Michael Connolly of the Composites Division stated: “The ACCE team is grateful for Peggy’s critically important contributions to the program over the years. Clearly, the ACCE 2017 team will have a huge void to fill with Peggy’s absence.”

Peggy’s B.A. in English and Philosophy from Franklin & Marshall College in the Lancaster, PA area has also served the Automotive Division well. As Webmaster and Newsletter Editor, we could always count on Peggy to provide grammatically correct edits, in a thoroughly professional manner.

It was a pleasure to work with Peggy. She has led the division to countless Pinnacle and Communications Awards through the SPE and, hopefully, some of her instruction, good examples and organizational skills will stick with the team. We wish Peggy well in all future endeavors.



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ANTEC[®] 2017

May 8-10, 2017

Hilton Anaheim
California, USA

BY DR. NORM KAKARALA



During the 75th Anniversary Year of the SPE, the Annual Technical Conference (ANTEC 2017) will be held in Anaheim, CA at the Hilton from May 8 to 10th. The event theme is to Connect, Learn, and Celebrate while sharing your knowledge with the global audience. Norm Kakarala is serving as the Technical Program Committee (TPC) Chair for the Automotive Division for the ANTEC 2017. Any questions on paper submissions, please direct them to Sriman.kakarala@gmail.com for support and navigation.

Here are few Highlights of requirements the presenters at the ANTEC 2017 need to follow:

- No abstract due date is specified.
- Both purely Technical Papers and Applications with technical content Papers are allowed.
- Written Papers or Presentation Files (PowerPoint) without written papers are acceptable.

- All papers and submitted presentation files need to be approved by the Review Committee for inclusion on the Program.
- All Papers or Presentations need to be submitted through the e-touches system (Details provided on the SPE Call for Papers Announcement for ANTEC 2017)
- The **due date for the Papers or Presentations** for Committee Review is by **January 13th**
- **Final Papers or Presentations** with all changes required by the Review Committee **need to be received by February 27th**

We plan to have a good Automotive Sessions at the ANTEC with thought provoking presentations. When papers or presentations are submitted please ensure to select the Automotive Session for your participation.

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Paper submission deadline: January 13, 2017

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SECRETARY'S REPORT

SPE Automotive Division Board
August 22nd, 2016 Meeting Minutes



ATTENDEES

Matt Carroll	Bonnie Bennyhoff	Alper Kiziltas	Suresh Shah
Tom Pickett	Crystal VanHouten	Cynthia Flanigan	Al Murray
Dhanendra Nagwanshi	Dave Reed	Ron Price	Steve Van Loozen
Brian Grosser	Dave Helmer	Peter Bejin	

*Ph: Fred Deans
Peggy Malnati
Nippani Rao
Teri Chouinard
Kevin Pageau*

Meeting was held at the ACC (American Chemistry Council) in Troy, 5:32pm – 7:30pm

MEMBERSHIP – Steve Van Loozen
946 Active Members

OPENING –Matt Carroll

Need an Awards Chair. Need an AutoEpccon Lead – will keep Steve Van Loozen but if there are any volunteers, please speak up.

COUNCILOR'S REPORT – Suresh Shah

Submitted a six-page report of his take on the Council meeting in Quebec. Official meeting minutes will be published by SPE HQ.

GUEST SPEAKER (by phone) – Russ Broome, Managing Director of SPE

1. Design in Plastics conference, sponsored by SPE HQ, with assistance from Bob Grace, will be hosted at the College for Creative Studies in Detroit in 2017. Conference will be the same week as the Innovation Awards. Russ suggested inviting parties that attend one event to also attend the other event. There will be a completely different set of sponsors for the design conference than the Innovations Awards. The Design in Plastics conference is directed to all plastic industry professions in areas of automotive, packaging, furniture, housing, etc. Steering Committee Support from Steve Van Loozen on this event
2. ANTEC 2019 will be held in Detroit at the Detroit Renaissance Center. It falls within the same timeframe as the AutoEpccon. Suggestion of bringing AutoEPCON in house with ANTEC that year? Suggestion was made for Russ to start with the AutoEPCON steering committee and then go from there.

FINANCIAL – Bonnie Bennyhoff

Account Balances – Checking \$192,096.01, Savings \$22,446.25, PayPal \$0 for a total of \$219,542.26 USD.

- Fiscal year runs from July to June.
- Reviewed Annual Financial Report for Fiscal Year July 2015 – June 2016. Motion made to approve; all approved, no objections.
- Reviewed Budget for Financial Report for Fiscal year 2016-2017. Motion made to approve; all approved, no objections.

MARCOM – Peggy Malnati

Report on Automotive Composites Conference, Innovation Awards Gala, and Website

NEWSLETTER – Dave Helmer

Dave Helmer has taken over as the Editor. Newsletter has been completed and formatted. Planning to have additional copied printed for the ACCE.

Automotive Composites Conference & Exhibition (ACCE):

A strong program with lots of new technology. Very good sponsorship with 65-70 sponsorships.; 90 presentations; 5 keynotes; 1 panel; Event is financially sound.

NEW BUSINESS

- Schedule of future Automotive BOD Meetings – October 3, 2016.
- Concern with SPE HQ wanting to increase memberships fees. Would like Councilor (Suresh Shah) to bring it to the next SPE HQ Board meeting.
- Motion to let SPE International know it is ill advised to increase rates. All agree, no opposed.
- Tom Pickett has been elected for the Lifetime Achievement award by the Detroit Section. He will be recognized in September 2016.
- New Director of Detroit Section – Eve Vitale – invite to a division meeting.
- Concern with students commuting to and from the IAG; SPEAD should have a formal policy regarding transportation such as professional transportation (students not driving themselves). More discussion to be had.

Innovation Awards Gala (IAG): Program Guide Template is completed; signage templates created; 2 press releases distributed to date. The theme is Plastics: Innovation in Motion. The Gala is scheduled for the evening of November 9, 2016 at the Burton Manor in Livonia, MI

Website: Website traffic is showing 4,789 hits in June 2016 and 5,093 for July 2016.

Suggestion from a leader from another SPE event potential for a joint TopCon marketing effort to join forces with the largest and longest running conferences to share best practices and negotiate reciprocal advertising/promotions. More to come on this topic.

Next Meeting: October 3rd, 2016 at ACC in Troy.

Meeting adjourned.

Minutes



SECRETARY'S REPORT

SPE Automotive Division Board
October 3rd, 2016 Meeting Minutes



ATTENDEES

Matt Carroll
Chuck Jarrett
Brian Haggart
Tom Pickett

Dhanendra Nagwanshi
Alper Kiziltas
Cynthia Flanigan
Fred Deans

Bonnie Bennyhoff
Crystal VanHouten
Dave Helmer
Steve Van Loozen

Teri Chouinard
Mark Lapain
Jay Raisoni

*Ph: Al Murray
Peggy Malnati
Andy Stecher
Suresh Shah
Jeff Helms*

Meeting was held at the ACC (American Chemistry Council) in Troy, 5:33pm – 7:13pm

OPENING –Matt Carroll
Review of Agenda for Meeting

INTERSOCIETY REPORT – Dhanendra Nagwanshi
ESD (Engineering Society of Detroit) Networking event held on 9/21/2016. Gold Award banquet held in March 2017. We can submit a nomination of a colleague for outstanding contribution. The ESD Webpage to display our upcoming events

EDUCATION – Fred Deans
SPE Michigan State University invited us to attend their section meeting on October 11th @6:30pm to give a general presentation on SPE Automotive Division. Fred Deans will attend with Nippani Rao.. Fred requested an SPE "Who We Are and What We Do" type of presentation and Peggy Malnati forwarded a version.

MARCOM – Peggy Malnati
Report on Automotive Composites Conference, Innovation Awards Gala, and Website

Automotive Composites Conference & Exhibition (ACCE): 2nd largest Technical program; attendance of 861; 2nd largest sponsorship; largest student poster competition. Executive committee is currently working on a post-conference report. 2017 ACCE Conference will be Sept. 6th-8th @ Diamond Center in Novi, MI.

Innovation Awards Gala (IAG): Program Guide Template is completed; signage templates completed; 1st round of parts judging concluded; Blue Ribbon judging to commence on October 10th. The Gala is scheduled for the evening of November 9, 2016 at the Burton Manor in Livonia, MI. Several press releases have already been distributed, along with swap ads. Several more releases are stuck in external approvals or in the works.

Website: Website traffic is showing 8,713 hits in August 2016.

Misc: Plastics News asked for a swap arrangement. SPE Automotive Division would be granted booth space at the Plastics News event in January in exchange for an email blast from Headquarters and a mention on the website and materials for the SPE ACCE. Motion made to approve swap. No objections, all in favor

MEMBERSHIP – Steve Van Loozen

A new member report just released today with more features. Will report changes at next meeting. Committee will ask SPE International to allow an option for multi-year sign up or an auto-renew option upon initial signup. Membership inquiry cards will be left on the tables at the IAG event. For the newsletter, there was a request to include a "New Member Welcome" section.

IAG – Matt Carroll

Chuck Jarrett will be the vehicle lead for the event. Multiple OEM vehicles will be displayed. Committee in full swing to obtain sponsorship.

COUNCILOR'S REPORT – Suresh Shah

Main discussions surrounded financials, Governance Task Force and membership renewal fees increased and reinventing ANTEC. Next meeting will be held virtually on December 7th, 2016.

FINANCIAL – Bonnie Bennyhoff

Account Balances – Checking \$369,575.01, Savings \$27,448.10

Motion made to contribute 5,000 USD to the Jackie Rehkopf Scholarship in 2017; all approved, no objections.

NEWSLETTER – Dave Helmer

Deadline for information & articles for the December newsletter is 11/14/2016.

NEW BUSINESS

- In April of 2017, there will be a vote to determine the Automotive Division Board members.
- Peggy Malnati will be departing SPE at the end of the year. Peggy has made a vast contribution and influence on the Automotive Division and the events held. She will be greatly missed.
- Mark Bahm from Detroit Section agreed to serve as our Webmaster starting in December but he does not want to commit for a long term.
- Communications chair is needed and a separate IAG Marcom lead position and/or ACCE lead position may be created.
- Bonnie & Teri will write up a scope of work for the Communication Chair position needed for the Automotive Division

Next Meeting: December 5th, 2016 at ACC in Troy.

Meeting adjourned. 25



SOCIAL REPORT

by Teri Chouinard,
SPE Automotive Div. Social Chair



SPE Automotive Division Golf Outing Benefits Student Chapters & Scholarships

This year's Golf Outing was a huge success! The event included more sponsors, fun and funds raised for SPE Student Chapters and scholarships than ever before.

We had 18 sponsors including 12 who sponsor regularly and 6 new sponsors. Once again PETS — Plastic Engineering & Technical Services sponsored the dinner and Celanese sponsored lunch. Both PETS and Celanese have supported our golf outing and other SPE programs for many years. Neutrex/Purgex, (Longest Drive) and iD Additives (Closest to the Pin) returned to sponsor contest holes. Other loyal returning hole sponsors included Addcomp, Ashland, BASF, Chromaflo, Finkl Steel, Plasan Carbon Composites, Poly Ad Services, and Trinseo. New hole sponsors included Albis, Autodesk, Carver Non-Woven Technologies, EMS-Grivory, and RCO Engineering. New sponsor M.Holland, sponsored a contest hole (Longest Putt) and a Putting Contest which made the event more fun and raised additional funds for SPE Student Chapters and Scholarships.

It was a beautiful day of fun, fresh air and camaraderie at the award-winning Fieldstone Golf Club in Auburn Hills, Michigan, USA. The course 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 with gently rolling fairways through majestic hardwoods.

Now approaching its 23rd year, the golf outing attracts over 100 automotive plastics-industry professionals. Foursomes are only \$500, which includes continental breakfast, lunch at the turn, and a nice buffet dinner. The scramble format makes it fun for all levels of play. Trophies for first, second and third place teams make it competitive for more advanced golfers. Your participation helps us to support SPE Student Chapters and scholarships that benefit the future of our industry. Next year's event is scheduled for Tuesday, September 5, 2017. Go to www.speautomotive.com/golf.htm for more details.

Thank you Ron Price! Once again, we greatly appreciate your photos of this year's Golf Outing.



First Place Team: M. Holland



Second Place Team: PETS – Plastics Engineering & Technical Services



M. Holland sponsored a fun putting competition raising additional funds for SPE student chapters.



Amateur Tour Hopefuls

Thanks to our sponsors for making our 22nd golf outing a big success!

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COUNCILOR'S REPORT

August 20th – 21st, 2016 Council Meeting Minutes
Quebec City, Quebec

by Suresh Shah, SPE Automotive Div. Councilor

Overall Themes of Discussion included reorganization of Governing Body, details of transition and by-law changes and modifications that must be made to insure smooth transition. Special review of Leadership Lane and how it can be used to assist functioning of Sections and Divisions. Breakout sessions were held to identify ways of improving membership value, membership volume as well as ways to Improve ANTEC. Proposal passed to increase member dues, which haven't been raised in roughly 8 years.

COUNCIL MEETING I — Saturday Morning – Aug. 20th, 2016

Financials

- Operations is looking at shortfall due to revenue, mostly in membership. Expenses were under budget to help offset some of this.
- Financial performance (investments) exceeded budget by \$60k which should roughly offset the losses due to operations
- Cash management is in good shape, but will be tight due to normal seasonality
- We are reaching a lot of people due to e-membership which is around 21,000. Current, premium membership is 13,154.
- Topcons are showing increases in revenue and profits. Advertising revenue on increase, which is due to on-line membership numbers. Wim indicated that SPE HQ is looking into having topcons in niche areas as long as they do not compete with divisions and sections.
- Motion was made to increase SPE membership dues. For new members from \$144 to \$155, and for renewing, increase from \$129 to \$155.
- Sections will now get straight rebate based upon number of members. Should see increase in rebate in 2017

Pinnacle Awards

Plan to restructure this award's format and procedures. Need help with Task Force to establish metrics for the award. Goal is to focus on member value. Areas are communications, outreach, programming, education, and students / next gen.

Plastics Insight

- Need to encourage use. Number of users and "clicks" equals revenue

- Sorts internet info into relevant topics for plastics professionals
- Can customize individual data you can get
- Provides feedback to SPE on areas of interest. Direction for programs, TOPCON's etc.

CCOW, SECTION AND DIVISION MEETING

- Nomination for new Student Chapter at Imperial College of London (U.K.)
- Section to be abandoned – Rochester, NY
- Extensive Non-Compliance list (mostly for missing rosters)
- TOPCON Review

**NOTE – PRODUCT DESIGN & DEVELOPMENT DIVISION
LOOKING FOR SECTION TO WORK WITH FOR TOPCON. WILL
SPLIT REVENUE 50/50 WITH SECTION. ED PROBST IS CONTACT.**

Reinventing ANTEC

- Negatives
 - Declining attendance, papers and revenue
 - Causes? – quality of papers, loss of relevancy (internet/overlap of conferences), specialized conferences, limited resources of members/industry
- Positives
 - History
 - Breadth and depth of knowledge
 - Bridge between academia and industry
 - Global Reach
- Goals
 - Rebuild core strength
 - Technical (and soft) skill set development
 - Improved networking opportunities
 - Joint themes with other organizations around topics of education/regulatory/NPE "field trips"

Governance Task Force

- Final Stages of Implementation of new Governance Body. By-laws is critical
- Recruitment and development of leaders for executive positions is key. Recognized need to improve process of nominating candidates for positions.
- Concern over ability to hold elected members of board accountable and responsible for doing the job. Top executives to review performance. Need guidelines for removing non-performing members.

COUNCIL MEETING I — Saturday Afternoon – Aug. 20th, 2016

By-Laws and Policies

- Governance Task Force (GTF)-majority of changes were related to new Governance Procedures and checks and balances necessary to make it effective. Effective date will be July 1, 2017.

CCOW, SECTION AND DIVISION MEETING

Sunday Morning – Aug. 21st, 2016

- ANTEC Student Sponsorship was \$54k. All divisions and sections contributing were recognized
- Automotive division had issues with “for profit” organizations using SPE Logo to promote their events, which often compete with SPE events. Need to police and stop practice for any “profit based” organization not only to use SPE logo but to name SPE as a sponsor of their event. Local sections and divisions need to be careful with agreements to allow use of SPE logo to “profit based” organizations which not only compete with SPE but also undermine volunteers. If swapping for advertisement is required, it has to be approved by board and study case by case.
- Sustainability division is looking for help and participation. Need corporate commitments and individual participation. “Who is sustainability contact at your organization?”

Leadership Lane – Dashboard Training

- SPE is finishing up a database that will provide detailed membership for the section and division use. Can be downloaded for Section Use. October 1, target launch.
- All data will be communicated to *Membership Chair*.
- *All Board Members need to be on Leadership Lane. Automotive division SPE should be set up on it.*
- Using SPE site for events (registration) will help build database for membership.

Guest Speaker: Robin Waters, Director IHS

- Topic: Value Chain of Plastics in Chemical Industry
 - Slow growth globally and NA. Brexit slower short term
 - Low oil prices slowing chemical investment
 - Next 5 years, slow growth due to weak economic outlook globally
 - Growth is spreading globally, less regional
 - Project continuing decline in investment in Capital for Chem and Plastics
 - M&A will increase as a result
 - Iran Sanction Lifting will provide great unknown in 2020/2021 time frame
 - China responsible for 50% of plastics growth over next 5 years.
 - 5 year forecast for Engineering and Commodity Resins

Marketing Resources / Support

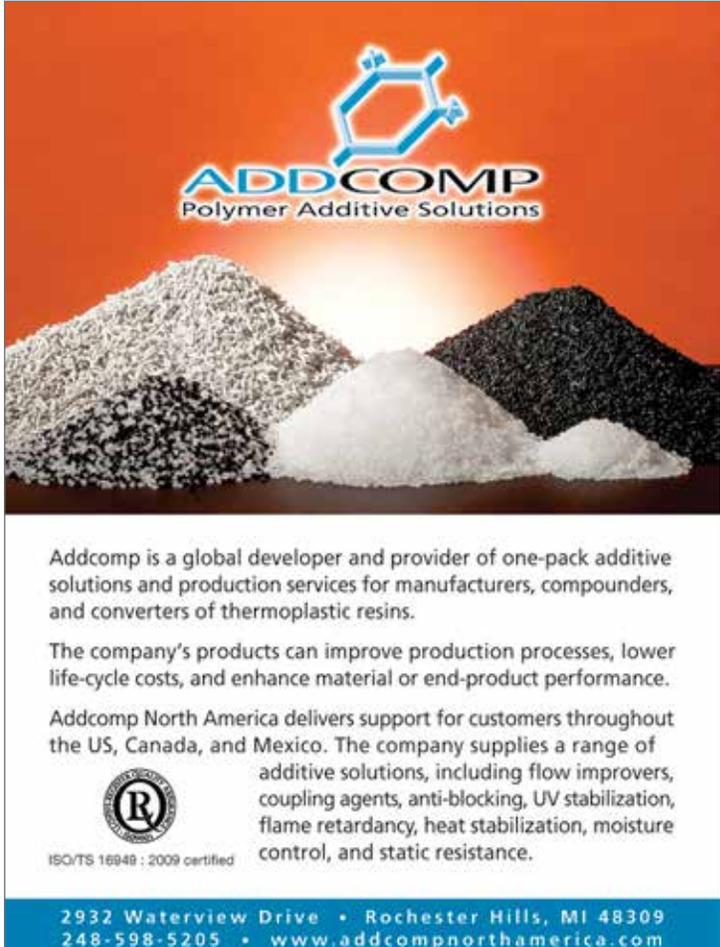
- Sue Wojnicki principle contact. swojnicki@4SPE.org
203-740-5420
- How to get best service for marketing SPE events
- Uniform branding of SPE services and events
- Conference Website / Advertise / Chain / Leadership Lane / Email blasts
- Best practices for Presentations and Conferences are/will be posted on “The Chain”

Old / New Business

- SIG: Update on progress of role of Special Interest Groups as part of or within SPE.
 - This was follow-up from session at Pittsburgh meeting.
 - Issues focused upon purpose, goals, finances and accountability.
 - Participation in SPE Activities when purposes align
 - Conversion of SIG into Division or abandonment needs to be formalized.
 - Staying SIG, as opposed to becoming a Division, for financial benefit is not acceptable. Governing Board needs to address.

Next Council Meeting:

- Virtual Council Meeting Wed. Dec. 7th 11:00 AM EST (2 hrs)



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INTERSOCIETY REPORT

by Dhanendra Nagwanshi,
SPE Automotive Division Intersociety Chair

I would like to say hello as your new SPE Automotive Division Intersociety Chair. The immediate task for me is to reinvigorate interactions with other professional organizations that also focus on the plastics or automotive industries like ESD, SAE, SME, ACMA etc., and explore ways to cooperatively work. Recently we participated in a couple of events from other societies to enhance interactions and below are quick updates.

Engineering Society of Detroit – ESD’s affiliate Council Fall Networking event took place on September 21st, at IBio Building, Wayne State University. Representatives from other societies like ASM, ASME, SAE, ACS, ASCE, SME, IEEE etc. participated in this event. Mr. Dan Doyle from the Detroit Metro Convention & Visitors Bureau spoke about various initiatives and ongoing developments in and around Detroit. SPE was acknowledged for upcoming ANTEC and Plastics for Design conference events in collaboration with the Detroit Metro Convention & Visitors Bureau. It was great to interact with representatives from other societies, and listen to ideas and updates about social, industrial and commercial developments in Detroit area.

SAE Detroit section’s 2017 GMC Acadia event took place on November 17th at San Marino Club, Troy. Key members of the General Motors team surrounding the development of the 2017 GMC Acadia gave a presentation.

We are always looking for new and innovative ways to work with other societies, so please forward any ideas you might have.

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Technical Report

Effects of Processing Parameters on the Thermal and Mechanical Properties of LFT-D-ECM Glass Fiber/Polyamide 6 Composites

Y. Fan, Y.C Liu, T. Whitfield, T. Kuboki and J. T. Wood

Department of Mechanical and Materials Engineering, University of Western, London, Ontario, Canada

V. Ugresic

Fraunhofer Project Centre for Composites Research University of Western Ontario

Abstract

In this work, the influences of the process parameters (i.e. melt temperature, extruder fill level, glass fibre (GF) temperature and screw speed of the mixing extruder) on the thermal and mechanical properties of the dry, as-molded materials were investigated. The material system of focus is 30wt% GF reinforced polyamide (PA6) manufactured via the Direct Long Fibre Thermoplastic Extruder Compression Molding (LFT-D-ECM) process. Characterization by tensile, flexure and impact tests on both the in-flow and cross-flow directions was carried out. Glass transition temperature, which plays an important role in the properties and failure mechanism of PA6 composites, was examined using dynamic mechanical analysis (DMA) and the degree of crystallinity was measured by differential scanning calorimetry (DSC). Fill level and melt temperature were observed to play the greatest role in determining the properties of the composite. The effects of processing parameters on glass transition temperature, melting temperature and the relative degree of crystallinity values of composites are presented.

Introduction

Due to the high impact resistance and recyclability, long fiber reinforced thermoplastic (LFT) has gained a rapid growth recently, especially in the automotive industry as a replacement for traditional metal parts [1-4]. In terms of processing, LFT can be divided into three types: glass mat thermoplastics (GMT), long fiber thermoplastic granules (LFT-G) and direct long fiber thermoplastic (D-LFT). Having combined the advantages of relative high performance (GMT) and low cost



ABOUT YING FAN

Dr. Ying Fan, a research engineer in the Department of Mechanical and Materials Engineering at **Western University** (formerly University of Western Ontario; London, Ont., Canada) has been named a winner of the **Dr. Jackie Rehkopf Best Paper Award** by the peer-review committee for the **SPE® Automotive Composites Conference & Exhibition (ACCE)**. She co-authored a paper entitled *Effects of Processing Parameters on the Thermal & Mechanical Properties of LFT-D-ECM Glass Fiber/Polyamide 6 Composites* that was presented at the sixteenth-annual SPE ACCE conference. Previously, Fan was a postdoctoral associate in the Department of Mechanical & Materials Engineering at Western University working under Dr. J. T. Wood from 2013-2015. Before that, she was an associate professor at Hebei University of Technology in China from 2009-2013, an assistant general manager at Yingzida Materials Co. Ltd. in 2009, and an assistant professor at Dalian Jiaotong University from 1997-2002. She earned a doctorate in Mechanical Engineering (Polymer Engineering) from Western University in 2008 and has published more than 30 peer-reviewed journal papers.

(LFT-G), D-LFT has been developed into injection molding compounding process (LFT-D-IMC) [5] and extruder compression molding process (LFT-D-ECM) [6]. The latter process employs two extruders for the polymer-additives plasticizing and fiber-polymer compounding respectively as well as a hydraulic press for compression molding [7].

In general, the core of LFT-D-ECM process is a single screw or two co-rotating screws. The screw is always designed to provide desired mixing quality with separate modules, such as kneading, conveying and restricting modules. In order to increase the mixing quality, some parameters, such as the screw speed, can be adjusted. But on the other side, the high shear flow, which is required for good mixing quality, might bring damage to the fiber. Shimizu [8] concluded that the total number of rotations and shear stress are the major factors which influence the fiber breakage. According to the empirical formulation listed below, the relationship between different processing parameters and fiber length can be predicted [9].

$$k_2 = \frac{(L_2) (\rho) (f) (N) (A_f)}{F} \quad [1]$$

where k_2 is the key factor for the average glass fiber length in a composite, L_2 is the length of the mixing section of extruder, ρ is the average density of the material, f is the fill ratio, N is the screw speed, A_f is the free cross section of the extruder, and F is the feed rate of the composite. Therefore, in order to optimize the mechanical properties, the processing parameters need to be controlled to find a balance between mixing quality and fiber length distribution. Czarnecki and White [10] proposed a mechanism for fiber breakage during rotation in shear flow for polystyrene composites. Fisa [11] reported that more fiber breakage was found when screw speed, mixing time and fiber content increased in polypropylene (PP) based composites. Wall [12] also found that average fiber length decreased with increasing screw speed. Yilmazer and Cansever [13] concluded that when the shear rate increased via a high screw speed or low feed rate, the average fiber length decreased. However, impact strength, Young's modulus, and tensile strength increased, whereas elongation at break decreased. Priebe [14] found that higher screw speeds generated shorter fibers, but had little effect on mechanical properties and lower viscosity polymer led to short fiber in PP/GF composites. G. Ozkoc [15] reported that the increased screw speed reduced the fiber length and also had some negative effect on mechanical properties. The increased extrusion temperature helped increasing the final fiber length and therefore improved the mechanical properties. Jonas [16] and Rodgers [17] studied the effect of screw speed and filling level on mechanical properties of PA66/CF and reported that the screw speed had very little influence on the measured material properties and increased filling level had negative effect on mechanical properties. Mechanical properties are typically the main area of focus when characterizing the effect of processing conditions [18-20] because ultimately they are the most desirable attribute of composite materials. However, the factors that affect these properties are also of high importance for further process optimization. Knowledge of causal factors comes from understanding molecular structure and material behaviour during high temperature processing. Thermal properties have previously been used with an effort to characterize the effect of modifications to the processing conditions during fabrication of a PA6/GF composite [21, 22].

In this paper, the specimens are manufactured using a LFT-D-ECM line. The influence of processing parameters, including screw speed, filling level, melt temperature and fiber preheating, on the thermal properties of the compression molded composite are studied by means of thermogravimetric and DSC analyses in an attempt to better describe some of the causal influences of material property changes. Mechanical performance including tensile, flexure and impact are also characterized, with stiffness compared to theoretical predictions.

EDITOR'S NOTE: Read the rest of this award-winning paper in the SPE ACCE Archives at:
http://speautomotive.com/SPEA_CD/SPEA2016/pdf/TP/TP9.pdf

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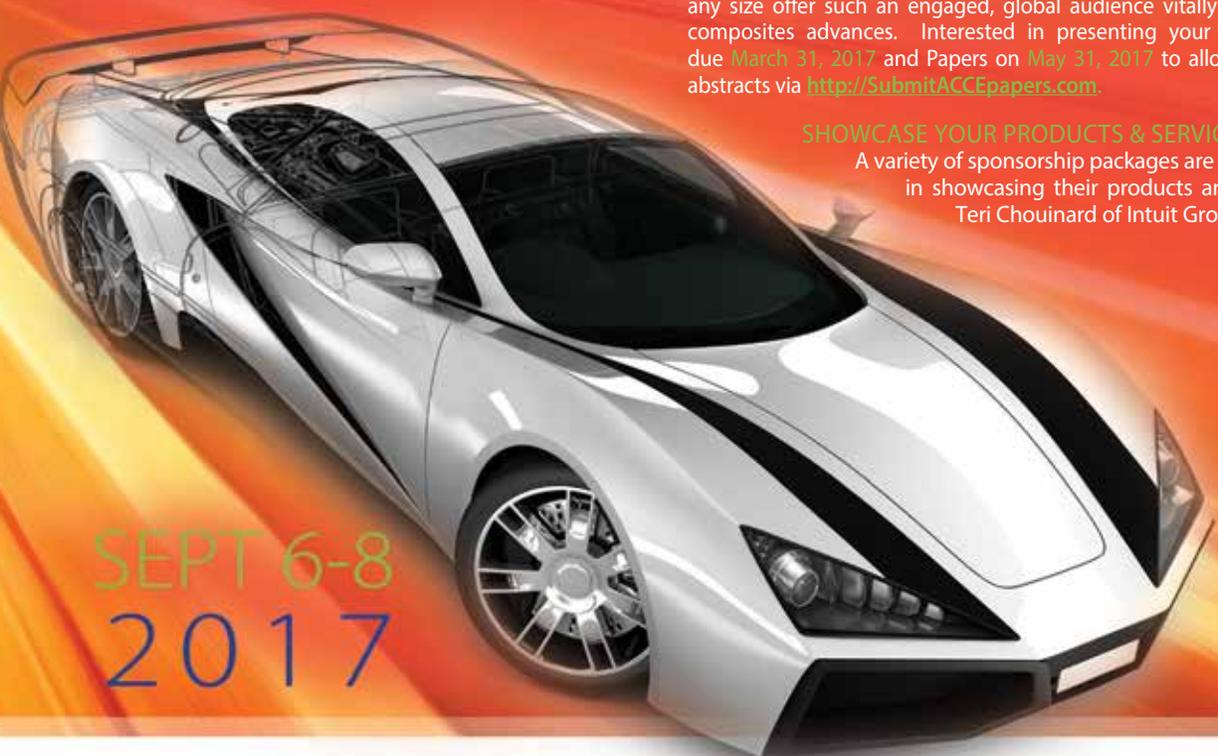
You're invited to attend the 17th-annual SPE Automotive Composites Conference and Exhibition (ACCE), September 6-8, 2017 in the Detroit suburbs. The show – which has become *the world's leading automotive composites forum* – features technical sessions, panel discussions, keynotes, receptions, and exhibits highlighting advances in materials, processes, and equipment for both thermoset and thermoplastic composites in a wide variety of transportation applications.

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ABSTRACT DEADLINES

50-word abstract: February 28, 2017
Presentations: April 8, 2017 (no paper required)

SUBMIT ABSTRACTS TO:

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