A PUBLICATION OF THE AUTOMOTIVE DIVISION OF THE SOCIETY OF PLASTICS ENGINEERS

SPE® AUTOMOTIVE

AUTOMOTIVE PLASTICS News

MARCH 2014
VOLUME 43, ISSUE 3

14th Annual SPE Automotive Composites Conference & Exhibition

This year's ***SPE® Automotive Composites Conference & Exhibition*** (ACCE) returns **September 9-11, 2014** to The Diamond Banquet & Conference Center at the Suburban Collection Showplace in Novi, Mich. in the Detroit area. Now in its fourteenth year, the show is the ***world's leading forum for automotive composites*** and draws over 900 exhibitors, speakers, and attendees from 15 countries on five continents. This year's theme is ***Composites: Meeting Today's Automotive Needs***.

Dr. Michael Connolly, program manager - Urethane Composites at Huntsman Polyurethanes, 2014 SPE ACCE conference co-chair explains, "Our conference has been fortunate to experience some pretty significant growth in the past few years, thanks to a rebound in the North American automotive industry along with considerable interest among all transportation OEMs on the subject of *lightweighting* and the role composites can have in helping them achieve mass-reduction goals. That means our committee is working harder than ever to ensure we provide a strong technical platform for discussing the latest advances in transportation composites as well as an expanding our exhibition area with suppliers from all parts of the automotive composites supply chain."

Antony Dodworth, managing director, Dodworth Design and the 2014 SPE ACCE co-chair adds, "This year's conference theme reflects our commitment to show automakers that composites aren't just something to solve *future* transportation issues. The composites supply chain is actively engaged in solving problems today by improving cost, weight, aesthetics, and safety performance of cars and light trucks."

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AUTOMOTIVE DIVISION MEETING SCHEDULE & SPECIAL EVENTS CALENDAR

SPE AUTOMOTIVE

Auto. Div. Board Meeting
American Chemistry Council - Auto. Ctr. — 5:30 - 7:30 pm
Troy, MI USA — April 14, 2014

SPE ANTEC Conference
Rio All Suites Resort & Casino — ALL DAY
Las Vegas, NV USA — April 28 - 30, 2014

9th-Annual SPE AutoEPCON Conference
MSU Management Education Center — ALL DAY
Troy, MI USA — May 6, 2014

Auto. Div. Board Meeting
American Chemistry Council - Auto. Ctr. — 5:30 - 7:30 pm
Troy, MI USA — June 16, 2014

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

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

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

Second Round / Blue Ribbon - Automotive Innovation Awards Judging
Celanese Corp. — 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

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 Yvonne Bankowski Merritt at auto-div-chair@speautomotive.com for more information.

CHAIR'S MESSAGE

Yvonne Merritt
SPE Automotive Division Chair

Fellow Members,

I hope this time of year finds you staying warm. I think those of us in the Northern Hemisphere are all ready for spring to arrive soon!

There are two SPE conferences coming up in the next few months in which the Automotive Division is involved. All members are encouraged to register and attend these shows.

- ANTEC®, the annual technical conference of SPE will take place at the Rio Hotel April 28-30, 2014 in Las Vegas, Nevada, U.S.A. The Automotive Division so far has 14 papers that will be presented in two sessions on April 29. Thank you to board members Anthony Gasbarro for collecting and reviewing abstracts and Suresh Shah for moderating both sessions.

- AutoEPCON, the Automotive Engineering Plastics Conference will take place May 6, 2014 at the MSU Management Education Center in Troy, Michigan, U.S.A.. The 9th-annual conference is jointly sponsored by the Automotive Division and Detroit Section. Thank you to board members Nippani Rao and Norm Kakarala for their efforts in organizing this conference.

I would like to remind all current and lapsed members to renew their annual SPE membership dues. The SPE International website for membership renewal has been updated, and renewing your membership is much easier and more straightforward than in past years. Let us know what you think.

Our Membership Chair, Steven VanLoozen, and the membership committee have recently come up with a plan to boost memberships and reach out to managers and directors at the local OEMs. Also, look out for an email survey coming out soon about the benefits of SPE membership to you. Please take 5 minutes to fill out this short survey.

The next two board of directors meeting will take place Monday evenings at 5:30 p.m. on April 14 and June 16, 2014 at the American Chemistry Council 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.

Last but certainly not least, two of our board members are ill and would greatly appreciate being kept in your thoughts and prayers: Ed Garnham, House chair, and Jackie Rehkopf, Treasurer.

I look forward to seeing you at our upcoming events.

Sincerely,

Yvonne Merritt

Yvonne Merritt
2013-2014 SPE Automotive Division Chair

AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION

World's Leading Automotive Composites Forum

SOCIETY OF PLASTICS ENGINEERS
AUTOMOTIVE & COMPOSITES DIVISIONS

Those interested in speaking at this year's event should submit **abstracts** by **March 30, 2014** and **full papers or presentations** are due **May 30, 2014** to the review committee via **ACCEpapers@speautomotive.com**. Authors who submit full papers (not presentations) in the proper format will be considered for the conference's Best Paper Awards, which will be presented during the event's opening ceremony.

Held annually in suburban Detroit, the ACCE provides an environment dedicated solely to discussion and networking about advances in the transportation composites. Its global appeal is evident in the diversity of exhibitors, speakers, and attendees who come to the conference from Europe, the Middle East, Africa, and Asia / Pacific as well as North America. Fully one-third of attendees indicate they work for automotive and light truck, agriculture, truck & bus, heavy truck, or aviation OEMs, and another 25% represent tier suppliers. Attendees also work for composite materials, processing equipment, additives, or reinforcement suppliers; trade associations, consultants, university and government labs; media; and investment bankers. The show has been jointly sponsored by the SPE Automotive and Composites Divisions since 2001.

For more information see **http://speautomotive.com/comp.htm** or **http://specomposites.com**.

Call for Part-Competition Nominations

The SPE ACCE is now accepting nominations for its annual parts competition nominations. One winner in each of three categories — *Body Exterior* and *Body Interior* (with each winner selected by members of the SPE ACCE committee), and *People's Choice* (selected by conference attendees) — will be selected, with winning teams receiving recognition and a trophy during lunch on the last day of the show. There is no cost to enter the competition. Any registered conference participant (speakers, sponsors/exhibitors, or attendees) may nominate original equipment or aftermarket composite parts on passenger cars or light trucks in any geography. The only requirement is that parts must be on a vehicle available for commercial sale and the OEM must give permission. Nomination instructions will be found at **http://speautomotive.com/comp.htm**. Preliminary descriptions and photos about the application's innovations are due **August 30, 2014** and should be eMailed to **ACCEpapers@speautomotive.com**. Physical parts must be brought to the SPE ACCE for final review by judges during a formal walk-through at the show.

Last year, Plasan Carbon Composites swept the competition in all three categories. The company's nomination of the hood for the *Corvette Stingray* sports car from General Motors Co., produced in carbon fiber-reinforced composites via Plasan's new out-of-autoclave pressure press technology, won the *Body Exterior* category. And Plasan won both *Body Interior* and *People's Choice* awards with its nomination of the engine X-brace on the *SRT Viper* from then Chrysler Group LLC (now Fiat Chrysler Automobiles) produced in autoclave-cured carbon composites. In 2012, the first year that the SPE ACCE featured a parts competition, Asahi Kasei North America won the Best Part award with its nomination of the twin-sheet thermoformed glass-reinforced polypropylene composite on the Ram Box assembly with lid on *Dodge Ram* pickups from then Chrysler Group LLC.

PURE MICHIGAN®
Michigan Economic Development Corporation

Michigan Economic Development Corp. Sponsors 2014 SPE® Automotive Composites Conference Scholarships

SPE's ACCE organizing committee is once again accepting nomination forms for its annual ACCE scholarships. As they did last year, the Michigan Economic Development Corp. (MEDC, Lansing, Michigan, U.S.A.) will sponsor two historic SPE ACCE graduate scholarships (given annually since 2007), as well as one new scholarship (first given in 2013) for an undergraduate or graduate student enrolled in a Michigan educational program. The MEDC's support covers two $2,000 USD ACCE scholarships for graduate-level research in polymer composites that has impact on ground transportation, as well as one new $2,000 USD scholarship for a junior or senior undergraduate or graduate student pursuing a degree in polymer science, plastics, composites, or a related engineering curriculum in a Michigan college or university. Applications for all three scholarships are due **July 20, 2014** and forms can be found at **http://speautomotive.com/comp.htm**; winners will be selected from a pool of qualified applicants and announced in early August 2014 before this year's SPE ACCE show.

"As the lead agency for economic development for the State of Michigan," says Amy Cell, MEDC's senior vice president for Talent Enhancement, "the MEDC is committed to ensuring that industry has the pipeline of talent it will need for the future. SPE's Automotive Composites Conference and Exhibition is an event that focuses on both the current and future needs of one of Michigan's most important industries. Every dollar that we invest in these engineering scholarships is an investment in Michigan's success in the future."

About MEDC

Pure Michigan is a brand on the rise, representing business, talent, and tourism initiatives across Michigan. These efforts are driven by the Michigan Economic Development Corp. (MEDC), which serves as the state's marketing arm and lead agency for business growth, jobs, and opportunity with a focus on helping grow Michigan's economy. For more on the MEDC and its initiatives, visit: **http://www.michiganbusiness.org**. For Michigan travel news, updates, and information, visit **http://www.michigan.org/.**

COMPOSITES

MEETING TODAY'S AUTOMOTIVE NEEDS

SPE AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION

World's Leading Automotive Composites Forum

SOCIETY OF PLASTICS ENGINEERS
AUTOMOTIVE & COMPOSITES DIVISIONS

CALL FOR PAPERS

EXHIBIT & SPONSORSHIP OPPORTUNITIES

ATTEND THE WORLD'S LEADING AUTOMOTIVE COMPOSITES FORUM

The Automotive and Composites Divisions of the Society of Plastics Engineers (SPE®) invite you to attend the 14th-annual **SPE Automotive Composites Conference and Exhibition** (ACCE), **September 9-11, 2014** in the Detroit suburbs. The show – which has become ***the world's leading automotive composites forum*** – will feature technical paper sessions, panel discussions, keynote speakers, networking receptions, & exhibits highlighting advances in materials, processes, and applications technologies for both thermoset and thermoplastic composites in a wide variety of ground-transportation applications.

PRESENT BEFORE AN ENGAGED, GLOBAL AUDIENCE

The **SPE ACCE** draws over 900 attendees from 15 countries on 5 continents who are interested in learning about the latest composites technologies. Fully a third of attendees work for a transportation OEM, and roughly a fifth work for a tier integrator. Few conferences of any size offer such an engaged, global audience vitally interested in hearing the latest composites advances. Interested in presenting your latest research? ***Abstracts*** are due **March 31, 2014** and ***Papers*** on **May 30, 2014** to allow time for peer review. E-mail abstracts or papers to ACCEpapers@speautomotive.com. Approved papers will be accessible to attendees on a cloud-based server and later will be available to the general public.

SHOWCASE YOUR PRODUCTS & SERVICES

A variety of sponsorship packages – including displays, conference giveaways, advertising and publicity, signage, tickets, and networking receptions – are available. Companies interested in showcasing their products and/or services should contact Teri Chouinard of Intuit Group at teri@intuitgroup.com.

FOR MORE INFORMATION

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http://speautomotive.com/comp

SEPTEMBER 9-11
2014

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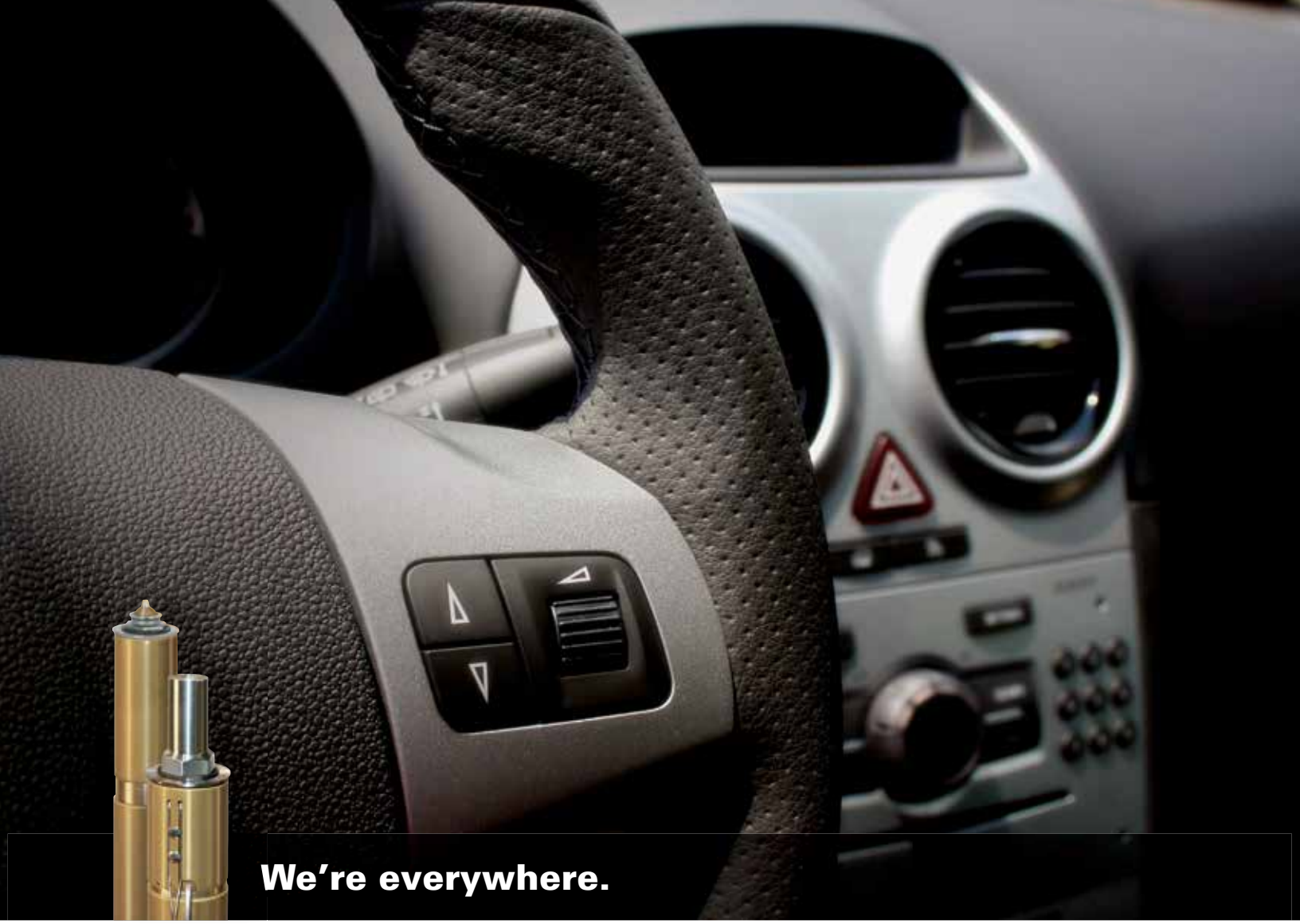
SUBURBAN COLLECTION SHOWPLACE

The Diamond Banquet & Conference Center at the Suburban Collection Showplace
46100 Grand River Ave. Novi, MI 48374 USA

DIAMOND CENTER



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BATTER'S BOX
Guest Columnist

Why the Aluminum F-150 Is Important to You

By Gary S. Vasilash, Editor-in-Chief, Automotive Design & Production

Gary Vasilash has been covering the automotive industry for more years than he wants to calculate. He once drove a '94 Saturn SL2, a car that he bought specifically because he was intrigued with the materials used for the body panels. Otherwise, he didn't think a whole lot about the car.

Without a doubt, the huge news at the North American International Auto Show (NAIAS) in Detroit this past January was the public introduction of the 2015 *Ford F-150* pickup.

From the get-go, Ford described the truck as being "the toughest, smartest and most capable *F-150* ever." Mark Fields, Ford Motor chief operating officer stated, "The all-new *F-150* redefines the future of trucks, and it is yet another example of our One Ford plan producing vehicles that serve customers with a commitment to the very best quality, fuel efficiency, safety, smart design, and value."

Know well that the *F-150* is pretty much the basis of the entire Ford franchise. That is, in December 2013, Ford sold 74,592 *F-Series* trucks. No, not all of them were *150s*, but you can be confident that that was the greatest trim selected.

During the entire year of 2013, Lincoln sold 81,694 vehicles—total.

That's a difference of just 7,102 units. A vehicle. A division. That's the sort of thing that *F-Series* sales mean.

For 2013 in total, Ford moved 763,402 *F-Series* trucks, making it the best-selling truck in the U.S. for 37 years running and the best-selling vehicle in the U.S. for 32 years.

The word "important" is probably insufficient to describe that truck in relation to Ford's overall business.

The "smart" that is referred to is for things like 360° cameras for parking and the like; LED spotlights for the sideview mirrors; a wiring harness for the trailer hook up that IDs any issues (e.g., burned out tail lamps) and notifies the driver; adaptive cruise-control; lane-keeping assist, and other electronics-based items.

But let's let the other shoe drop. The body of the 2015 *F-150* is aluminum. Or, in Ford parlance, "High-strength, military-grade, aluminum alloys – already used in aerospace, commercial transportation, energy, and many other rugged industries."

What's more, "Customers using the *F-150* for construction, mining, and utilities have tested and helped prove out its high-strength aluminum alloy cargo box."

Get the picture: Ford is using aluminum for its truck and it wants to assure the public that it is not going to have all of the structural integrity of an empty beverage can.

So why am I going on about an aluminum-intensive vehicle in a publication that's for the plastics industry? Simple. Because if nothing else, the 2015 *F-150* is arguably the strongest message possible that so far as at least Ford is concerned, business as usual is over. Things that have been taken for granted—like pickup trucks are made of steel—are no longer the case.

Ford recognizes that as 2025 CAFE regulations loom ever larger as the time gets ever closer, it must undertake a thorough-going change to the way that it puts its trucks and cars together. It must consider and reconsider. Weigh the part mass. Weigh the part cost. And it must calculate how it is going to eke out ever-more fuel efficiency from its vehicles.

Reducing vehicle mass—Ford is talking 700 pounds for the *F-150*, although it is not specifying precisely how much of that is directly predicated on the aluminum body—means that powertrains can be concomitantly downsized because there is less mass to move. Suspension components can be made lighter, brakes can be made smaller, and on it goes. (Of course, when you add all of that "smart" stuff and other features and options, things bulk up a bit, but that's pretty much non-negotiable nowadays: people like their tech.)

Plastics producers and processors ought to look at the *F-150* from the point of view of it being a signal to an opportunity in the auto industry like they've never had before. This is not to be considered simply a case of "Gee, we may get the chance to do more part substitution, a bit here, a bit there. . . ."

Batter's Box CONTINUED FROM PAGE 8

No, this is a signal that tremendous changes are possible.

Let's go back to those sales numbers. In 2013, Ford sold 77,186 Mustangs. That's 2,594 more cars for the year than it sold *F-Series* trucks in December.

If Ford was going to be tentative about things, wouldn't it have made more sense for the company to have announced that the 2015 *Mustang* would be made of aluminum rather than the MOST IMPORTANT VEHICLE in its lineup?

If something goes south for the 2015 *F-150's* "high-strength, military-grade aluminum alloys," then they are in for not the proverbial but the actual world of hurt. It won't be pretty.

As is fairly well known, when it comes to things like deploying new or different technologies, there is a profound tendency for risk-aversion. "That's not the way we do it" is a phrase that many automotive engineers have used over the years for the simple reason that they're not particularly interested in the potential for something "different" to have a career-ending consequence. Their career.

Raj Nair, Ford group vice president, Global Product Development, said at the time of the *F-150's* intro, "To meet the needs of our truck customers, we created smart new features and a whole new approach to using advanced materials and engines to improve capability and efficiency."

Ford's product development people not only are helping Ford's truck customers, but they are also helping the organization overall, again in order to address CAFE. Just imagine how not meeting the bogey for fuel efficiency for something that you're selling over three-quarters of a million units on an annual basis.

Now is the time to act. Now is the time to be bold. Now is the time to pull out those ideas that have been developed and shelved, ideas for more extensive uses of plastics and composites for both inside cars and trucks and outside, as well. Ideas that probably caused more than an eye roll or two.

Have no doubt about it. Every single OEM on the planet is going to be looking for the ways and means to make their cars and trucks lighter. They're going to be undoubtedly considering things that they would never have considered before. (Wouldn't you have liked to have been a fly on the wall when the first person walked into their boss's office in Dearborn and said, "You know the 2015 *F-150?* We ought to make it out of aluminum.")

To be sure, the people in the steel industry are going to step up their game.

The stakes are really high and getting higher.

And think how exhilarating it must have been in the offices of the several aluminum companies that Ford worked with on the *F-150* program when they saw the size of the orders.

Conceivably, that is the sort of thing that could happen for several plastics companies as they receive bigger pieces of other programs. (As we're in the truck terrain here, it's interesting to note that last year GM sold 664,803 *Chevy Silverados* and *GMC Sierras* combined, and as those trucks have just been redone and are not due for even a minor change for some time to come, so it's worth keeping in mind that there are other vehicles that have big numbers too, though none as big as the *F Series*.)

As everyone will tell you, the future of vehicle engineering and construction is "multi-material." Ford emphasizes that "the frame uses high-strength steel rated up to 70,000 psi—stronger than the steel found in some competitor's heavy-duty pickup truck frames" and that "eight through-welded cross-members provide increased thickness."

Sure, they're using plastics. But not to the extent that they're using aluminum and steel.

The simple situation is this. The game has changed. The auto industry is recognizing that one way *and* another they're going to have to do things entirely differently than they have been doing for about the past 100 years. Next year we're going to see Hyundai, Toyota, and Honda with fuel-cell powered vehicles, and other companies with theirs the following year. How different is that?

So would it be so bizarre to think that if a plastics company had a real game-changer that they'd be left out of the game? While that may have been the case not that long ago, when Ford unveiled the 2015 *F-150* at NAIAS on January 13, 2014, that's when all of the rules changed.

There has never been a better time to get in the game. If you have a technology, if you have an approach, if you have a material, if you have an idea, and any or all of them are going to help automakers save weight, then now is the time to get a chair at the table because you can't win if you don't play.

9TH-ANNUAL

AUTO EPCON

CALL FOR TECHNICAL PRESENTATIONS

MAY 6, 2014

MSU Management Education Center Troy, MI, USA

DEADLINE FOR 50-WORD ABSTRACT: March 1, 2014

DEADLINE FOR PRESENTATIONS: April 8, 2014 No Paper Required

PROGRAM SCOPE The Automotive Division and Detroit Section of the Society of Plastics Engineers (SPE®) invite you to attend a 1-day technical conference & exhibition showcasing innovative developments in the Design, Materials, Processing, & Use of Engineering Plastics for the Global Automotive Industry.

WHO SHOULD ATTEND This conference is specifically designed to inform, update and educate the OEM & supplier communities about advances in both thermoset & thermoplastic engineering polymers. Learn how these widely used materials can help improve performance & productivity, while reducing cost and mass.

PRESENTATIONS Hear technical presentations on the newest advances in engineering materials related to: Design Engineering; Materials Development; Lighting; Thermal Management; Processing & Enabling Technologies; Predictive Engineering; New Applications & More.

EXHIBITS See Exhibits from Engineering Plastics Suppliers, Molders, Compounders, Additives & Reinforcement Suppliers, Design & Engineering Firms, & Machinery Suppliers. Experts will show you how to apply the latest technologies to your next project or program.

CONFERENCE INCLUDES Full Day of Technical Presentations, Plenary & Keynote Presentations on Automotive Business Trends, Lunch & Coffee Breaks, Exhibits of Advanced Technologies and Evening Reception.

Visit www.speautomotive.com/emc.htm, or contact us at karen@spedetroit.com.

Karen Rhodes-Parker, SPE Detroit Section (Ph: +1.248.244.8993 ext. 3)

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An Engineer's Life...

by Roger Assaker

CEO, e-Xstream engineering and
Chief Materials Strategist, MSC Software

I was born in Lebanon in October of 1968 as the youngest of three brothers. I grew up and lived in Lebanon until the end of high school in 1987 when I left to go abroad for university. In my home country, we are basically encouraged to get a good education, and most choose a career in either medicine or in engineering. I went the route of engineering. My father was a landscape architect who was passionate about math. One of my brothers, Richard, who is 11 years older than me, is a professor of Neurosurgery in Lille, France and has invented many medical devices. My other brother, Dany, who is 8 years older than me, holds a Master's degree in Civil Engineering and a Ph.D. in Aerospace Engineering. These days he is a manager at the Goodyear Technical Center in Luxembourg.

I finished a combined Bachelor's/Master's degree in Aerospace Engineering in 1992 at the University of Liège in Belgium. While I was working on that degree, my brother Dany worked at Solvay's headquarters in Brussels and helped me get the opportunity to do a couple of summer internships at the company. That proved to be my first contact with plastics. After graduating, I continued my education by following in Dany's footsteps and pursuing a Ph.D. degree at the University of Louvain, also in Belgium. My doctorate was in MagnetoHydroDynamics in Semiconductors. I chose Aerospace Engineering because it sounded exciting and because it was strongly computational mechanics and simulation based, and I loved that kind of work. While I was pursuing my Ph.D. degree, I did some teaching in solid mechanics and strength of materials, and that's where I met my future business partner, Professor Issam Doghri, who had recently left California after working for a software company for some years. A decade later, we co-founded e-Xstream engineering.

Before I'd even finished my Ph.D., I started my first full-time job as a Senior R&D Engineer in the Computational Mechanics Group at the Goodyear Technical Center in Luxembourg. Once again, my brother Dany arrived before me and helped me obtain an interview for a job that I was offered. It really was nice to be able to work with him and a team of friends. My work there was focused on developing methods and software for the effective and efficient modeling and simulation of tires. Our company, as many other major corporations, had invested millions of dollars in finite-element analysis (FEA) simulation working with all the major commercial software codes. However, when it came to material modeling for those commercial packages, we found that this area of work was underfunded and underdeveloped. To do my job, I mainly collaborated with Sandia National Laboratories in the U.S. and with different FEA software vendors working on topics such as fluid-structure interaction and uncertainty quantification. My work at Goodyear gave me the opportunity to issue a couple of trade secrets related to advanced modeling of tires. While working there, I completed my Ph.D. dissertation and then started work on an M.B.A. by taking evening classes at Sacred Heart University's John F. Welch College of Business in Luxembourg. I graduated as valedictorian in the Class of 2002. During my time as an M.B.A. student, I worked on a business plan to start e-Xstream engineering. After 5-1/2 years at Goodyear, I took a big risk and walked away from a nice career plan, and a comfortable salary and benefits at the end of 2002. I wanted to focus on starting my own company with my long-time colleague, Issam Doghri, whose research at University of Louvain focused in

An Engineer's Life CONTINUED FROM PAGE 12

material modeling and micromechanics. Interestingly, the business plan I wrote for e-Xstream won 2 competitions at regional (123GO) and European (Eurowards) levels of competition, and that helped us not only get a lot of free publicity, but also to meet two of the three investors who eventually would help fund the company's startup.

We began operations in May of 2003 and our first office was in Belgium. Less than a year later, we set up a second office in Luxembourg. Issam stayed at University of Louvain but worked as a consultant for us as head of R&D, a position he still holds. e-Xstream engineering is a software and engineering services company that is 100% focused on multi-scale modeling of reinforced plastics and composites. The company has been experiencing double-digit growth for the past decade and today is a key player in the materials modeling segment. Automotive is our most important market, followed by aerospace. It's funny but we see automotive moving from plastics toward composites, and aerospace moving from composites toward reinforced plastics, so we think we are positioned well to help both industries, since their needs overlap our core competence.

While I worked to build e-Xstream, I continued my education studying entrepreneurship (at Massachusetts Institute of Technology's Sloan School of Management), negotiation (Harvard Business School and Harvard Law School), and innovation (Louvain School of Management - UCL). In 2007, I won the Creative Young Entrepreneur award in Luxembourg. I love flying all over the world to visit with customers, learning about the problems they face, and helping them find creative custom solutions that we develop from scratch. However, as much as I love technology, I would never want to spend all my days sitting behind a desk and making the same report 10 times to my boss and my boss' boss, and so on. I get bored really fast if my work is repetitive.

In September of 2012, e-Xstream engineering was acquired by MSC Software. We continue to focus exclusively on modeling of advanced materials. After the acquisition, I kept my position as CEO of e-Xstream but added a new job as Chief Material Strategist at MSC, where "materials" are one of three strategic pillars, the other two being "parts" and "systems." My job is to help MSC make the connection between each of those three areas for our customers.

Today I am married to Florence, whom I tutored in math when we were both at university and she was studying Economics. Together, we have a 12-year-old daughter called Anouk, who is crazy about horses, and is showing great aptitude in math as well as early indications of an entrepreneurial spirit, since she wants to start a horse ranch. I like all kinds of outdoor and water sports, including scuba diving, sailing, snowboarding, and running — that is, when I'm not on a plane.

And my two brothers? Although we aren't working together at the moment, when we play golf we come up with 10 new ideas an hour. My surgeon brother has brought me in to help design a new medical device that replaced titanium with PEEK/carbon fiber composite for an intervertebral disc replacement. Who knows what the future will hold?

ABOUT ROGER ASSAKER

Roger Assaker, a tech entrepreneur, is CEO and co-founder of e-Xstream engineering, a software and engineering-services company that is 100% focused on advanced materials modeling. Since September 2012, he is also the Chief Material Strategist of MSC Software. He holds both Ph.D. and M.S. degrees in Aerospace Engineering with a strong focus on nonlinear computational mechanics – an area of expertise where he now has 20 years' experience. Assaker has complemented his engineering education with an MBA in International Business, plus has taken additional advanced business and technology entrepreneurship courses from prestigious universities such as Massachusetts Institute of Technology and Harvard. In addition to growing e-Xstream engineering into global leadership in advanced composite modeling, Assaker is also Vice-Chair of NAFEMS' Composite Working Group and an active member of other technical material associations such as SPE and SAMPE.

SPE ANTEC® 2014

ANTEC® REPORT

Anthony Gasbarro,
Technical Program Chair -
Automotive Session, ANTEC® 2014

Once again, I have the pleasure of being the Technical Program chair for the Automotive Division at SPE's annual technical conference (ANTEC®) this year. ANTEC is the largest technical conference held in the U.S. specifically dedicated to the plastics industry. 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.

In 2014, ANTEC will be held at the Rio All-Suites Hotel & Casino, Las Vegas, Nevada, U.S.A. from April 28-30. You can find more information at **www.antec.ws/**. Or see the preliminary schedule here:

http://www.4spe.org/sites/default/files/htmlemail/Advance-Program14.pdf

The automotive sessions will be held all day Tuesday, April 29. The morning session, ***Automotive Additives, Reinforcements and Fillers*** contains seven papers (we had a late entry which is not represented in the preliminary program, but will be part of the final program) and the afternoon session, ***Automotive Material Innovations***, contains seven papers. After our last paper is presented in the afternoon, we will hold our Automotive Division annual meeting. I hope to see many of you there. In fact, I'd love to see some additional support from our Automotive Division members for our session in Las Vegas.

Please feel free to contact me if you have any questions or comments or if you would like to help organize next year's Automotive Session at ANTEC.

Thank You

Anthony Gasbarro

ANTEC® REPORT Continued from page 15

Currently Planned Automotive Technical Session

Automotive Additives, Reinforcements and Fillers: Tuesday Morning

4 Case Studies to Discover the Possible Automotive Applications of Glass Beads

Paper # 1858887 | Frederic Juprelle, Sovitec

Solid glass beads can be used in a lot of different thermoplastics in order to improve the following properties: scratch and abrasion resistance, dimensional stability, processing, etc. The goal of this presentation is to show, with 4 case studies in automotive, the advantages given by the introduction of solid glass beads in different resins. The 4 case studies are: 1) Mix of glass in nylon compound in order to improve surface properties; 2) Filler PP compound with glass beads to improve scratch resistance; 3) Advantages of using glass beads in styrenic resins; and 4) New solid glass bead grade to improve PC properties.

Nucleation Efficiency of Talc in the Foaming Behavior and Cellular Structure of Polyolefin-Based Foams: New Perspectives for Optimized Lightweight Materials

Paper # 1864802 | Parashar Dave, Imerys

The research consisted in evaluating the nucleation efficiency of different types of talc (with different particle size distributions, morphologies and even surface modifications) in the foaming behavior and cellular structure of polypropylene-based materials, with the objective of developing lightweight materials with improved stiffness at lower densities. Nucleation efficiency was first evaluated in talc-filled PP foamed with a physical blowing agent inside a high pressure vessel. Depending on different talc characteristics, such as particle-size distribution, surface area, and morphology, cell density as much as doubled. Optimized foamed PP-talc composites prepared by injection molding using the MuCell® microcellular molding process displayed further weight reductions for similar stiffness values. There was some work done on polystyrene foams

Influence of Carbon Fibers used in Composites on Melt Viscosity of Composites in the Injection Molding Process

Paper # 1868608 | Kazuhisa To, Mazda Motor Corporation

The resin viscosity is an essential parameter to characterize the performance of injection molded products. However, it is very difficult to properly measure the viscosity of fiber reinforced composites during the injection molding process. In order to characterize the melt viscosity of fiber reinforced composites, capillary meters or rheometers are normally used. But the actual melt viscosities of composites in the injection molding process are not properly measured by those methods because shear rates realized by those methods are not high enough to mimic the shear rate during the injection molding process. In this study, an original molding tool is used to measure the melt viscosity of carbon fiber reinforced composites in the actual injection molding process. As a result, the influence of carbon fibers used in composites on melt viscosity during the injection molding process were properly characterized.

State-of-the-Art Additive in Automotive Plastics Applications or How Performance and Aesthetics can Meet Sustainability

Paper # 1885166 | Emilie Meddah, Clariant International Ltd.

Innovation in additives continuously enhances the offering to the plastic industry. Conversion processes of engineering thermoplastics compounds can be very demanding, especially when reinforced with fillers like glass fibers. Performance, quality, productivity, and weight reduction are the automotive industry drivers for plastic applications, combining excellence and awareness. The answer to these needs is the development of specific additives or solutions which provide to the compounds outstanding protection and process improvement ability, with a particular focus on sustainability.

Overview of Different UV Technologies

Paper # 1888397 | Dagmar Ehmann, Peter-Lacke GmbH

This presentation will focus on the various UV curing technologies used for paint coatings used on plastics. It will also focus on what curing technologies work best on particular plastics and their respective applications. Depending on the type of finish required and the requirements for the application different technologies are needed and this presentation will highlight the options available.

ANTEC® REPORT Continued from page 16

Spectrophotometric Assessment: The Challenges of 0/45-45/0 in a D8 World

Paper # 1886605 | Rex Petterson, Uniform Color Company

Determining the acceptability of an automotive interior has typically been accomplished through visual consensus and spectrophotometric analysis. As many have experienced in this all too subjective pursuit, not only can three or more separate sets of eyes discern three or more totally diverse variations in color acceptability, but our benchmark instruments of choice also can offer distinctly different opinions. Diversity in devices, innumerable surface-variation characteristics of the sample, and inherent human imperfection in the repeatability of the manual "reading" process are all contributing factors to spurious spectrophotometric results. We will discuss what instrumental options we have available in order to have our electronic results correlate with what we see.

Developing an Integrated Crash Simulation for Automotive Parts Produced from Natural Fiber Reinforced Plastics (NFC-Simulation)

Paper # 1870457 | Dr.-Ing. Thomas Baranowski, Ford Research & Advanced Engineering Europe

The interest in renewable materials in the car industry is growing dramatically. Natural fiber reinforced plastics or natural fiber composites (NFC) are an attractive solution, because of their interesting mechanical properties in combination to a good environmental performance and potential of short-medium term implementation. In order to be used on a large scale in the car development process, all vehicle components must prove that they meet product safety requirements and fulfill their performance specification. This is done via computer aided engineering (CAE) calculation methods. The project Natural Fiber Composites-Simulation (short: NFC-Simulation), which is described in this paper, established a complete and integrated solution for the simulation of NF composites, from material processing to crash simulation of automotive parts. In order to achieve these capabilities, many technical and scientific problems had to be solved in detail and the results integrated into a complete solution.

Automotive Material Innovations: Tuesday Afternoon

Product Advancements in ABS Metal Plating for Automotive Applications

Paper # 1871270 | Abboud Mohammed, Styrolution America LLC

The need for automotive exterior chromed applications with excellent surface appearance and good scratch / scuff resistance is well known. Typical exterior chrome applications (grilles / wheel covers) require no surface defects such as pits, scratches, or blush upon initial factory installation, and over ten years' field performance without delamination, blisters, or cracks. Recent advancements in the field of acrylonitrile-butadiene-styrene (ABS) and ABS + Polycarbonate (ABS+PC) blends have allowed for such a system that with the proper design and tooling considerations, it allows one to more closely match all of these expectations.

Lightweight Styrenics for Automotive Applications

Paper # 1871362 | Jinhwa Chung, Styrolution America LLC

The light weight of acrylonitrile-butadiene-styrene (ABS) and acrylonitrile-styrene-acrylate (ASA) thermoplastics has been studied with various weight-reduction technologies. One category includes density reduction of fixed dimensions by partially displacing polymer with gas or air. Chemical foaming agents (CFAs), MuCell® microcellular foaming [1], and glass bubble (GB) compounding are the most well-known technologies. The other category is the thin-wall injection molding. In both cases, acceptable balance of weight reduction and mechanical properties in finished parts has to be achieved. In this study, the changes of mechanical properties through CFAs, GBs, and thin-wall technologies are described.

ANTEC® REPORT Continued from page 17

Coatable Wood Plastic Foams for Automotive Applications

Paper # 1883986 | Eric Homey, University of Applied Sciences

The automotive Industry is searching for lightweight materials to decrease the energy that is needed to move a car, especially materials that can be used for mass production are requested. Assisted injection molding methods like the water injection process are capable of fulfilling these requirements. Another possibility to make thermoplastics even more lightweight is to foam them, although this causes a loss of mechanical strength. To improve the strength of the foamed material, natural fibers (NF) can be embedded. Both, the foaming and the use of NF led to an unsightly surface, so the surface on the exposed side had to be painted. State-of-the-art is to coat plastic surfaces with polyurethane (PUR). In this study an acrylonitrile butadiene styrene (ABS) reinforced with wood fibers (WF) was foamed. One aspect of the material choice was that it can be coated with PUR in a one-shot-process. The mechanical properties of NF and foam-modified ABS compounds were investigated.

Material Concept for Large-Scale Production of Finished Colored External Body Panels in Automobile

Paper # 1884040 | Jörg Hain, Volkswagen AG

Lightweight construction is the elementary key of the Volkswagen CO_2 reduction strategy. The goal is to design a car which is as efficient as possible. The reduction of energy usage during production of the car, as well during moving the car leads to research of new materials and new applications in the automotive Industry. The Volkswagen CO2 reduction strategy has many topics but in the paper we focus on three topics: The right material at the right place; Reach the best customer satisfaction; Use of new technology including multi-material design for steel, alumina, plastics. In the case of plastics is the use of foamed polymers in combination with in-mold coating is one focus of Volkswagen research. The following paper shows general lightweight aspects as well the topic "Class A" surface for foamed body panels with the goal to use this process in a large scale.

Polyester Compositions for Automotive Tube Coatings

Paper # 1886569 | Sarah Grieshaber, SABIC Innovative Plastics

Polyester blends were evaluated as a replacement for nylon in automotive metal tube coating applications by investigation of long-term chemical resistance and adhesion to metal. Resistance to many common automotive fluids and fuels was observed for up to 5000 h of exposure at 60°C. Adhesion to metal was achieved without the use of a primer, which is an advantage over nylon materials and has potential to facilitate the production process by eliminating the use of primers.

Metal Replacement with Specialty Thermoplastic Solutions in Heat-Sensitive Automotive Applications

Paper # 1886753 | Patricia Hubbard, PolyOne Corporation

Automotive OEMs are facing immediate and continuous short- and mid-term targets to improve fuel economy. Lightweighting and energy efficiency are key enablers to reach these targets. Lightweighting primarily involves implementing material solutions with an appropriate performance / weight ratio for an application, without compromising quality and costs. Energy efficiency mainly comes from powertrain innovations, including electrification of the car, with innovations in electronics (LED, power electronics, alternative energy, etc.) translated to automotive uses. Specialty thermoplastics have a key role to play in this respect. This paper will describe how thermally conductive thermoplastics can help achieve these targets, specifically in heat-sensitive automotive applications — from the fundamentals of thermal management and the corresponding material properties, to a case study of metal replacement in automotive LED lighting applications.

Evaluating the Effects of Using Post Consumer Polyamide 6 (PCR-PA6) Resin for Automotive Component Application

Paper # 1887908 | Anshuman Shrivastava, Delphi Packard

Plastics consumption into various products has substantially grown over the years. Increasing resin prices and escalating environmental legislatives towards landfills are encouraging recycling of plastics. Recyclability of thermoplastic materials facilitates innovative application established on their residual contents. The plastic scrap thus is classified into predominant categories as postindustrial resin (PIR) and postconsumer resin (PCR). Postconsumer resin (PCR) is recovered from recycled products such as disposable packaging containers, bottles, and commodities in landfills. Discarded carpets are becoming a compelling source of PCR-nylon resins. This paper evaluates the use of PCR-PA6 resin for automotive component application. The lifetime performance of these formulations was estimated through prolonged heat aging and testing at various intervals.

AUTOMOTIVE

Service through Science

by Dr. Jeffrey H. Helms

Global Automotive Manager, Celanese Engineered Materials

Growing up in North Carolina, I never was really much of a car guy. I think I actually liked motorcycles more until I permanently disabled one in a thunderstorm. Then I found that cars were a nice convenience, being a lot drier and warmer than the two wheelers. I completed my Bachelor of Science and Doctorate degrees in Chemistry at THE University of North Carolina at Chapel Hill. I would describe my doctorate as one in chemical physics where the primary focus was studying the absolute ground state of inorganic and organometallic compounds and then modeling the experimental magnetic behavior at <4.2K using a combination of Heisenberg spin models and *ab initio* methods.

When it was time to start earning money, I was actually considering a stint at the Naval Weapons Center in California in the field of artificial intelligence, or a position at the IBM Almaden Research Center in New York working in computational chemistry. Then I received a call from Ford Research in Dearborn, Michigan. At that time, the Ford Research Polymer Science Department wanted to start a new program in electroactive polymers, and they were looking for someone to define the program, set up a lab, and run some basic research work in the field. Wow, what an opportunity! So I started as a Principal Research Scientist in October of 1988 working on polymer electrolytes and electrochromic materials. That was the beginning of my 25+ year career in automotive.

My appreciation for the design and manufacturing of cars and trucks increased rapidly. The fact that thousands of parts could be designed, manufactured, and assembled at a rate of 1 job/minute and, most amazingly, every one of them started at the end of the assembly line, was nothing short of a miracle for a Physical Chemist. With part complexity, multiple material combinations, and automotive durability expectations, the learning opportunities were enormous. I think that everything I learned over the years in the area of plastics, coatings, and composites was somehow associated with eliminating a failure mode, solving a production quality problem, trying to drive cost and weight out of applications that previously had predominantly been made of metal, or creating new applications with the appearance and performance that customers expect in a significant investment like a car or truck. I spent 20 years of my career at Ford in several different roles including Manager of the Materials Research and Advanced Engineering Department of the Ford Research Lab, a short stint with Team Value Management operations dealing with a complex interaction of Purchasing, Engineering, Finance, and Cost Estimators, a few years handling the Paint Materials activity at Vehicle Operations for North American assembly plants, and then a few more years as the Chief Engineer of Materials Engineering, Testing and Standards. While my expertise now lies mostly in plastics, composites, and coatings, I know enough about steel, aluminum, and magnesium to be reasonably dangerous thanks to the different positions I have been given the opportunity to manage.

As time went by, most of these roles have become much more global in nature. This was and is a very interesting challenge. Most organizations seem to have developed as regional kingdoms over time and many are now trying to behave more globally for a variety of reasons. Automakers generally see the promise of efficiencies in global platforms with some regional tailoring for the target customer. This migration to an organization that wants to behave globally is, I think,

Service through Science

CONTINUED FROM PAGE 20

evolutionary. It does not happen quickly, and the personalities and cultural conflicts that arise must be dealt with carefully. Take something as critical as engineering standards. Ford and Mazda had a long-term relationship that dates back to the end of the Second World War. The shared platforms were a mix of Japanese and Western standards, including test methods such as JASO, ISO, and ASTM. Agreement on the number of bolts and bolt patterns on wheels was not an insignificant battle. Then add Jaguar, Land Rover, Volvo, and Aston Martin to the mix. I would venture a guess that General Motors/Adam Opel had similar challenges. In some ways, SPE also has to face these challenges in its mission to be the global source of technical information and education related to plastics engineering.

At the height of the 2008 financial crisis that crippled the North American auto industry and its suppliers, my career took a different path than most long-term OEM people envision. Since November of 2008, I have been at Celanese, first as the global OEM Manager in the automotive team for the Engineered Materials business (formerly Ticona) and now as the Global Automotive Manager handling the automotive OEM interface globally. This role has expanded my working knowledge of multiple OEM processes and design practices. As you might imagine, the Detroit 3 work significantly differently from the German and Asian OEMs. And add to that the new domestic Chinese, Indonesian, and Indian manufacturers. These "new" players also have visions of global production and sales, and are hungry for ideas that will help them to be competitive with the more established brands. From the material supplier side of the automotive business, we see opportunity in establishing a global footprint and capability that supports the global players no matter what region happens to be the lead in developing new programs. Some regions are more innovative than others, wanting to be first to market with a new material or new execution of an existing design. These industry leaders tend to accept a higher level of risk in order to be first to market, first to target, and first in customer perception.

After more than 25 years in the automotive industry, I can say that I continue to learn every day and continue to be surprised by what the automotive industry can accomplish. The industry environment today is a far cry from the dark days of 2008 and I think it is better positioned to deal with market ups and downs than at any other time over the past 25 years.

ABOUT JEFFREY HELMS

Dr. Jeffrey Helms received his Bachelor of Science degree in Chemistry in 1984 and his Ph.D. in Chemistry in 1988 at the University of North Carolina at Chapel Hill. In addition, he received his MBA degree from Michigan State University through the Executive MBA program in 2000.

Helms has been employed by Celanese Corp. (formerly Ticona) in the Engineered Materials business since November 2008 where he is the Global Automotive Manager. In this role, he is responsible for driving and coordinating the Celanese Engineered Materials product line growth at the OEM level.

Previously, Helms had been employed by Ford Motor Co. since October 1988. He held several positions in the Ford Research Laboratory including Plastics Technical Specialist and Plastics Research Team Leader, where he and his teams development conductive plastics, polymer electrolytes, and electrochromic polymer devices. In April of 2000, he took the position of Manager, Materials Research and Advanced Engineering. Projects within his department included activities in lightweight materials, corrosion, coating technologies, fuel-cell systems, materials characterization, biomaterials, and manufacturing technologies. After that, Helms held the position of Manager, Team Value Management, Ford North American Product Creation from June 2004 until April 2005. In this position, his primary emphasis was on delivering value to vehicle programs on high turnover commodities through technology, requirement rationalization, lean manufacturing, value-chain management, and balancing commercial and design opportunities with the potential and existing global supply base. In April of 2005, Helms assumed the position of Manager, Paint Material Development and Release in the Ford Global Paint Engineering organization. In this position, his primary responsibilities were coating materials development, certification, release and replication, paint quality improvement, as well as the development and implementation of paint materials strategies and environmental technologies supporting sustainable manufacturing. In February 2007, Helms became Chief Engineer, Materials Engineering, Testing and Standards. In this role, his responsibilities included materials specifications, approvals and testing, production and sourcing support for materials related opportunities/questions, corrosion engineering, global management of substances of concern for Ford and global engineering standards.

Helms is a member of SPE, SAE and the American Chemical Society.

MEMBERSHIP REPORT

Steve VanLoozen
SPE Automotive Div. Membership Chair

Following in the footsteps of our U.S. President, the Automotive Division has decided to make 2014 a year of action. We have formed a sub-committee focused on further increasing our membership and helping retain members. Members of the sub-committee include: Dave Reed, Teri Chouinard, Ron Price, Elias Shakour, Fred Deans, and myself. I would like to thank the team for all of their efforts in advance of detailing the actions we will take in 2014.

We have compiled a short 10-question survey that will be sent out to all current SPE Automotive Division members as well as recently lapsed members. The intent of the survey is to gain a better understanding of what those who've had experience with SPE consider to be the benefits of membership, as well as gaining insight on where we can improve and enhance the value of SPE membership to current and new members.

The Automotive Division will also initiate a new program providing 1-year memberships to select engineers working on lightweight initiatives at automotive OEMs. We believe having the OEMs actively involved in SPE will provide innovation opportunities for the entire automotive industry. Look for a new section to appear in the SPE Automotive Plastics News titled "OEM Corner" soon. It is our firm belief that facilitating an open dialogue between all members of the automotive supply chain is the best way to understand and overcome the challenges of the future.

Kind regards,

Steven VanLoozen

Steven VanLoozen
SPE Automotive Division Membership Chair

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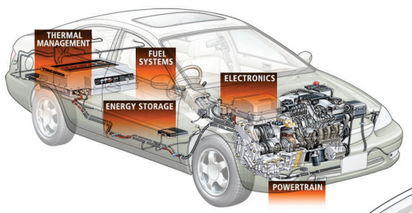

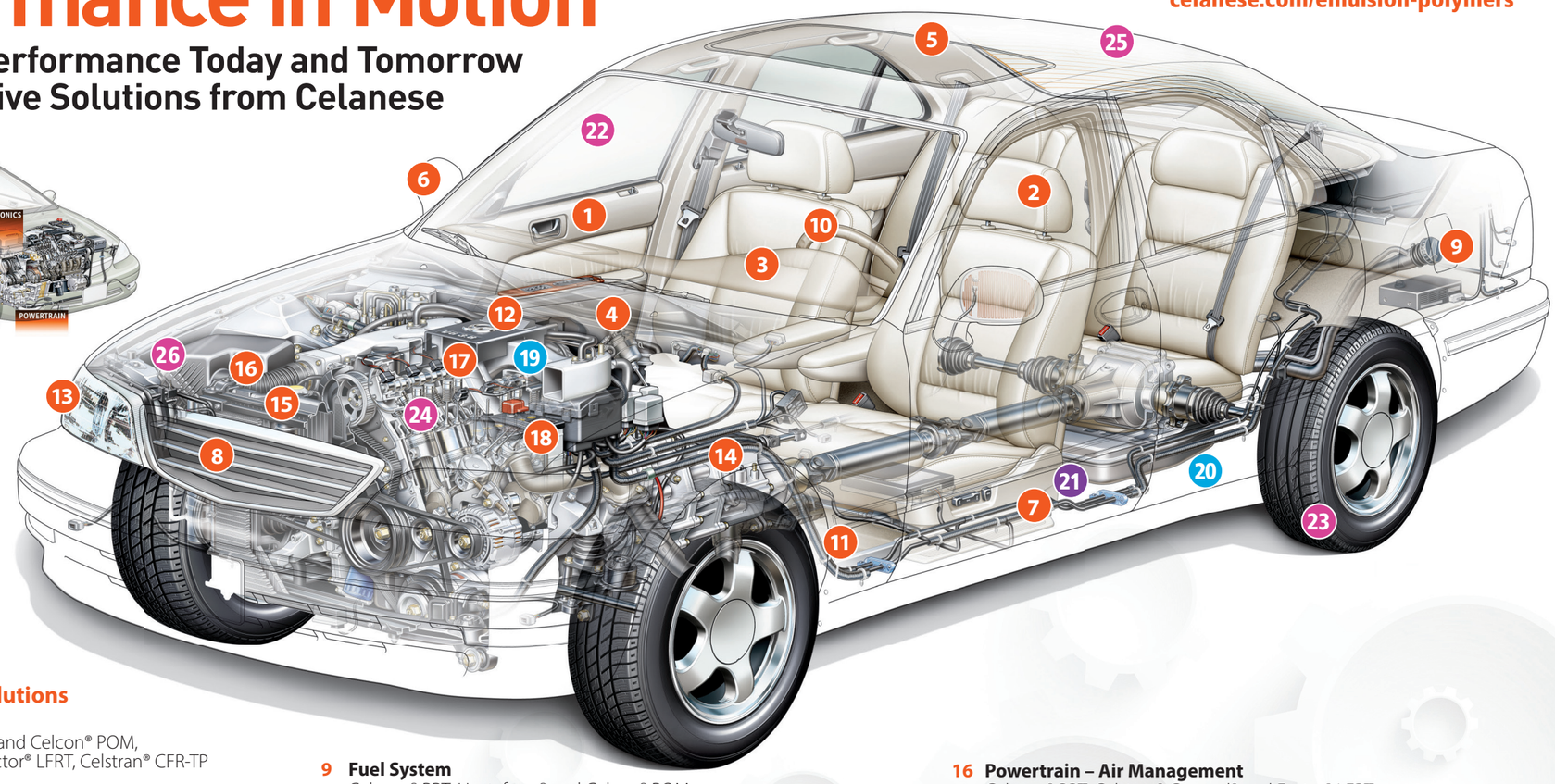

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1 **Door Modules**
Celanex® PBT, Hostaform® and Celcon® POM, Celstran,® Compel® and Factor® LFRT, Celstran® CFR-TP

2 **Seating and Restraint**
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3 **Instrument Panel –** Celstran,® Compel® and Factor® LFRT

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5 **Sunroof**
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6 **Mirror**
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7 **Fasteners and Supports**
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8 **Front and Rear End Modules**
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9 **Fuel System**
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10 **Cockpit**
Celanex® PBT, Hostaform® and Celcon® POM, Celstran,® Compel® and Factor® LFRT, Riteflex® TPC-ET, Vandar® PBT

11 **Chassis**
Celstran,® Compel® and Factor® LFRT, Celstran® CFR-TP

12 **Cross Car Beam –** Celstran® CFR-TP

13 **Lighting – Front and Rear**
Celanex® PBT, Vectra® and Zenite® LCP, Fortron® PPS, Thermx® PCT

14 **Powertrain – Transmission**
Celanex® PBT, Celstran,® Compel® and Factor® LFRT, Fortron® PPS, Vectra® and Zenite® LCP, Thermx® PCT

15 **Powertrain – Water Management**
Celanex® PBT, Celstran,® Compel® and Factor® LFRT, Fortron® PPS, Vectra® and Zenite® LCP, Thermx® PCT

16 **Powertrain – Air Management**
Celanex® PBT, Celstran,® Compel® and Factor® LFRT, Fortron® PPS, Vectra® and Zenite® LCP, Thermx® PCT

17 **Powertrain – Engine**
Celanex® PBT, Celstran,® Compel® and Factor® LFRT, Fortron® PPS, Vectra® and Zenite® LCP, Thermx® PCT, Riteflex® TPC-ET

18 **Electronics**
Celanex® PBT, Impet® PET, Vectra® and Zenite® LCP, Fortron® PPS, Thermx® PCT, Hostaform® and Celcon® POM

19 **Filtration –** Emulsion Polymers

20 **Sound Dampening –** Emulsion Polymers

21 **Flooring – Carpet –** Ateva® EVA Polymers

22 **Safety Glass –** Plasticizer WVC 3800

23 **Tires –** MIBK

24 **Engine Lubricant –** MIBC

25 **Coatings –** Polysolvan O®

26 **Electrostatic Coatings –** Monomethylamine

ENGINEERED MATERIALS

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- Excellent mechanical properties
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Celstran,® Compel® and Factor® Long Fiber Reinforced Thermoplastics
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- Inherent flame resistance
- High strength and dimensional stability

GUR® Ultra-High Molecular Weight Polyethylene
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- Self-lubricating properties/low coefficient of friction

Impet® Thermoplastic Polyester
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- Wide temperature use range

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- Outstanding chemical resistance
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Vandar® Thermoplastic Polyester Alloys
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- Broad chemical resistance
- Excellent electrical properties
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- EVA polymers available in wide melt index range

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INTERMEDIATE CHEMISTRY

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- Exceptionally low VOC content

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- Medium evaporation range
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SPE® Innovation Awards Competition & Gala
AUTOMOTIVE
HONORING THE BEST IN AUTOMOTIVE PLASTICS

SPE® Announces Dates, Deadlines for 44TH-Annual Automotive Innovation Awards Competition & Gala

For the 44th-time since 1970, the Automotive Division of the Society of Plastics Engineers (SPE®) has issued its annual call for part nominations and announced the date and location for the group's 2014 ***Automotive Innovation Awards Competition & Gala***, *the oldest and largest recognition event in the automotive and plastics industries.* This year's ***Awards Gala*** will be held **Wednesday, November 12, 2014** at Burton Manor (**www.burtonmanor.net**) in Livonia, Mich., where winning part nominations (submitted by **September 10, 2014**) and the teams that developed them will be honored during an evening that celebrates automotive plastics innovation.

Jeffrey Helms, global automotive director, Celanese Corp. who returns as the 2014 ***SPE Automotive Innovation Awards*** chair said, "This is a time of both great challenge and great opportunity in the automotive industry. Automakers in all parts of the world are working very hard to reduce the weight and emissions, and increase the fuel efficiency of their vehicles to meet new legislative mandates for 2025, or to reduce the cost of ownership where regulations on fuel economy are secondary to market development. However, as they pursue these goals, they cannot afford to sacrifice durability, aesthetics, safety, or convenience, nor can they allow their component costs to increase more than the market will allow. The plastics and composites supply chains are uniquely positioned to help automakers achieve these goals by using the power of component integration, reduction in tooling investment, more efficient designs, and the weight and performance benefits of plastics in so many parts of the vehicle. This year's theme is *Plastics Pay Off*, emphasizing the balance of design efficiency and tooling cost savings while meeting or exceeding customer expectations for the vehicles they buy. Events like the ***SPE Automotive Innovation Awards Competition and Gala*** have long highlighted the benefits offered by cutting-edge polymeric technologies in passenger vehicles and other forms of transportation."

Since 1970, the ***SPE Automotive Innovation Awards Competition*** has highlighted the positive changes that polymeric materials have brought to the automotive and ground-transportation industries, such as weight and cost reduction, parts consolidation, increased safety, and enhanced aesthetics and design freedom. At the time the competition started, many OEM designers and engineers thought of plastics as inexpensive replacements for more "traditional" materials. To help communicate that plastics were capable of far more functionality than their typical use as decorative knobs and ashtrays indicated, members of SPE's Automotive Division board of directors created the competition to recognize successful and innovative plastics applications and to communicate their benefits to OEMs, media, and the public. Over the years, the competition drew attention to plastics as an underutilized design tool and made industry aware of more progressive ways of designing, engineering, and manufacturing automotive components. From its humble beginnings, the competition has grown to be one of the most fiercely contested

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recognition events in the plastics and automotive industries. Today, polymeric materials are no longer substitutes for more expensive materials, but rather are the materials of choice in hundreds of different applications throughout the vehicle. Without plastics, many of the auto industry's most common comfort, control, and safety applications would not be possible. Current competition categories include:

- Body Exterior,
- Body Interior,
- Chassis / Hardware,
- Electrical Systems,
- Environmental,
- Hall of Fame,
- Materials,
- Process / Assembly / Enabling Technologies,
- Powertrain,
- Safety, and
- Vehicle Engineering Team Award (VETA).

During the competition phase of the event, dozens of teams made up of OEMs, tier suppliers, consultants, and polymer producers work for months to hone submission forms and presentations describing their part, system, or complete vehicle module and why it merits the claim as the year's "***Most Innovative Use of Plastics***." To win, teams must survive a pre-competition review and two rounds of presentations before industry and media judges.

There is no cost to nominate parts or vehicles. However, nominations that are accepted into the competition need to be presented (in person or by webinar) by their nominating teams during the first round of ***Automotive Innovation Awards Competition*** judging, **October 2-3**. Part finalists from that round will advance to a second presentation before a panel of Blue Ribbon judges on **October 13**. Winners of each part category, the Vehicle Engineering Team Award (VETA) winner, as well as a Hall of Fame winner will be announced during the ***Automotive Innovation Awards Gala*** on November 12.

SPE's Automotive Innovation Awards Program is the oldest and largest competition of its kind in the world. Dozens of teams made up of OEMs, tier suppliers, and polymer producers submit nominations describing their part, system, or complete vehicle and why it merits the claim as the *Year's Most Innovative Use of Plastics.* This annual event typically draws over 700 OEM engineers, automotive and plastics industry executives, and media. As is customary, funds raised from this event are used to support SPE educational efforts and technical seminars, which help educate and secure the role of plastics in the advancement of the automobile.

Learn more: **http://speautomotive.com/inno** and **http://speautomotive.com/awa.**

Call for Hall of Fame Nominations

Nominations are now being accepted for the 44th-annual **SPE® Automotive Innovation Awards Competition's *Hall of Fame (HOF)*** award category. The team representing the winning nomination will be honored at this year's ***SPE Automotive Innovation Awards Gala*** on **November 12, 2014** at Burton Manor in Livonia (Detroit Area), Michigan.

To be considered for a ***Hall of Fame*** award, the application must have:

- Been in continuous production for a minimum of 15 years;
- Been a game changer (must have led to significant changes in that category of part) over the years;
- Been recognized and used worldwide;
- Been considered a technical innovation in terms of materials, process, or application at the time of its introduction.

2013 Hall of Fame Award Winner
First Integrated Front-End Module

2011 Hall of Fame Award Winner
Superplug® Door Hardware Module

The winner of the Hall of Fame award is selected by a group of judges comprised of current members of the SPE Automotive Division board of directors, industry experts from OEMs and tier suppliers, as well as SPE Honored Service members, technical Fellows, and Lifetime Achievement award winners.

The last date for submission is April 15, 2014. Use the standard ***Automotive Innovation Awards*** part nomination form available at **www.speautomotive.com/inno.htm** (under forms).

Please submit the application electronically to Nippani Rao (**nippanirao@aol.com**) and David Reed (**fierodreed@sbcglobal.net**). The winner will be announced in June of 2014.

For more information on the ***SPE Automotive Innovation Awards Competition,*** see **www.speautomotive.com/inno.htm** or view our Awards Archives at For questions on the award, contact ***Hall of Fame*** committee co-chairs Nippani Rao or David Reed, or contact Dawn Stephens at **dawn@speautomotive.com** or call 1.248.244.8993 ext. 4.

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SPE® Calls for Vehicle Engineering Team Award (VETA) Nominations

As part of the 44th-annual ***SPE Automotive Innovation Awards Competition***, the SPE Automotive Division has issued its annual call for ***Vehicle Engineering Team Award*** nominations. The VETA prize honors the technical achievements of teams made up of automotive designers and engineers, tier integrators, materials suppliers, toolmakers, and others whose work – in research, design, engineering, and/or manufacturing – has led to significant integration of polymeric materials on a notable vehicle. There is no cost to nominate and any automaker in the world may nominate its eligible vehicles (and their innovative plastics and composites content). Winners will be honored at the 2014 SPE Automotive Innovation Awards Gala on November 12 at Burton Manor.

Previous winners of the competition include: Porsche AG for the 2004 model year (2004MY) *Porsche Carrera GT* supercar; Ford Motor Co. for three straight years with the 2008MY *Ford Flex* cross-over utility vehicle (CUV), the 2009MY *Ford Taurus* sedan, and the 2011MY *Ford Explorer* sport-utility vehicle (SUV); and Chrysler Group LLC for the *Chrysler 200* & *Dodge Avenger* sedans and the *SRT Viper* supercar.

2012 Vehicle Engineering Team Award Winner
Chrysler Group LLC'S 2013 MY SRT Viper® Supercar

SPE® Auto TPO Conference Organizers Announce 2014 Event Dates, Issue Call for Papers & Presentations

The sixteenth-annual ***SPE® TPO Automotive Engineered Polyolefins Conference***, *the world's leading automotive engineered-polyolefins forum*, returns to the Troy Marriott in the Detroit suburbs from **October 5-8, 2014**. This year's theme is *TPOs: Gateway to Innovations*. The organizing committee also has issued its annual call for papers, with **abstracts** due **April 18, 2014** and non-commercial **papers or presentations** by **July 31, 2014** (eMail both to **TPOpapers@auto-tpo.com**).

Bill Windscheif, president, Advanced Innovative Solutions, Ltd. and conference co-chair notes, "As automakers work very hard to reduce mass and cost while maintaining or improving aesthetics, safety, functionality, and other customer-desired features, they increasingly find that rigid and ductile thermoplastic polyolefins (TPOs) allow them to do more with less – quite literally, thanks to the low specific gravity of these materials. In concert with flexible thermoplastic vulcanizates (TPVs) and thermoplastic elastomers (TPEs), these workhorse materials are being used in more challenging environments on the vehicle thanks to the tremendous advances made in polymer modification, compounding, additives technologies, and process enhancements. For 16 years, SPE has highlighted the latest technologies for automakers and their supply base at our annual *TPO Automotive Engineered Polyolefins Conference*. Our show's continued focus remains to provide practical knowledge that can be implemented to improve first-pass yield and offer more value to customers.

Conference co-chair, Jeffrey Valentage, global market developer-Polyolefins, Specialty Compounding Automotive, ExxonMobil Chemical Company, adds, "TPOs, TPVs, and TPEs truly can be gateways to innovation for many important applications on passenger vehicles. Each year our conference attracts a larger and more international group of speakers, exhibitors, and attendees, which serves to underscore the growing demand for these versatile families of materials."

This year's technical program is co-chaired by Dr. Norm Kakarala, Inteva Products LLC and Peter Grelle, Plastics Fundamentals Group LLC. Sessions currently planned for the event include: ***Advances in Automotive Polyolefins*** organized by Neil Fuenmayor, LyondellBasell and Laura Soreide, Ford Motor Co.; ***Rigid Polyolefin Compounds*** organized by Mike Balow, Asahi Kasei North America and Ermanno Ruccolo, Mitsui Plastics, Inc.; ***Bio-Based Polyolefin Materials*** organized by Susan Kozora, International Automotive Components (IAC) Group and Dr. Ellen Lee, Ford Motor Co.; ***Interior Soft Trim & Sealing Systems*** organized by Dave Helmer, General Motors Co. and Robert Eller, Robert Eller Associates; ***Surface Enhancements*** organized by Dr. Rose Ryntz, IAC and Jim Keller, United Paint Co.; ***Lightweight Polyolefin Parts*** organized by John Haubert, Fiat Chrysler Automobiles and Normand Miron, Milliken Corp.; ***Adhesives & Coatings for TPOs*** organized by Hoa Pham, Avery Dennison and Dr. Pravin Sitaram, Haartz Corp.; and ***Thermoforming of TPO Materials*** organized by Ed Bearse, Advanced Plastics Consultants and Rob Philip, Mytex Polymers.

ABOUT THE TPO CONFERENCE

Since 1998, the ***SPE TPO Automotive Engineered Polyolefins Conference*** has highlighted the importance of rigid and flexible polyolefins throughout the automobile – in applications ranging from semi-structural composite underbody shields and front-end modules to soft-touch interior skins and bumper fascia. Engineered polyolefins have been the fastest-growing segment of the global plastics industry for more than a decade owing to their excellent cost / performance ratio. The show typically draws more than 700 attendees from 20 countries on four continents who are interested in learning about the latest in rigid and elastomeric TPO as well as TPE and TPV technologies. Fully a third of conference attendees say they work for a transportation OEM, and roughly 20% work for a tier integrator / molder, with the balance from materials or reinforcement suppliers, equipment OEMs, industry consultants, and members of academia. A variety of sponsorship packages are available for companies interested in showcasing their products and / or services. The show is organized by volunteers from the ***Detroit Section*** of the ***Society of Plastics Engineers*** (SPE).

OCT 5–8, 2014

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The SPE TPO *Automotive Engineered Polyolefins Conference* typically draws over 600 attendees from 20 countries on 4 continents who are vitally interested in learning about the latest in rigid and elastomeric TPO as well as TPE and TPV technologies. Fully a third of conference attendees work for a transportation OEM, and roughly 20% work for a tier integrator. Few conferences of any size can provide this type of networking opportunity or put you before such an engaged, global audience vitally interested in hearing the latest olefin advances. Interested in presenting your latest research? *Abstracts* are due April 18, 2014 and *Papers/Presentations* in July 31, 2014. E-mail abstracts/papers to TPOpapers@auto-tpo.com.

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Multi-Scale Modeling of High Cycle Fatigue of Chopped and Continuous Fiber Compounds

Thierry Malo, Laurent Adam, Roger Assaker
e-Xstream engineering

Tsukatada Matsumoto, Riccardo Giacomini
Toyota Motor Europe

Abstract

The structural durability of an automotive component is one of the most expensive attributes to test, thus one of the most appealing for CAE. Fatigue modeling of chopped and continuous fiber polymer composites is challenging due to their anisotropic, heterogeneous and viscous material properties as well as their process-dependent microstructure. In this context, the ability to model high cycle fatigue (HCF) of fiber reinforced composites was developed in Digimat®.

A first model, based on macroscopic S-N curves and using the pseudo-grain modeling technique, was developed and implemented for chopped fiber reinforced plastics (FRP). It enables computing the S-N response for any fiber orientation state.

A second fatigue model, based on damage evolution in the matrix phase, was developed to address failure of continuous fiber reinforced plastics (CFRP).

The two micro-mechanically based composite fatigue models will be presented and discussed in this paper.

The macro pseudo-grain fatigue model was applied to an automotive plastic part, made of a nylon 6.6 material reinforced by short glass fibers. Experimental fatigue testing was performed both on test coupons and parts. To define the fatigue models, and evaluate their accuracy and robustness, specimen testing was done at different R ratios; a focus on R=-1 will be made. The developed models enable computing the S-N curves locally in every element of a finite element (FE) model and provide that information to fatigue software that compute the fatigue lifetime of the part. The presentation will aim at describing the model and its ability to accurately compute high cycle fatigue by showing correlation between finite element analysis (FEA) and experimental data.

Thierry Malo, engineering services team leader at *e-Xstream engineering*, an MSC Company, was named a *Best Paper Award* winner by the peer-review committee for the SPE® Automotive Composites Conference & Exhibition (ACCE). Malo was lead author (along with Laurent Adam and Roger Assaker, also of e-Xstream engineering, and Tsukatada Matsumoto and Riccardo Giacomini from Toyota Motor Europe) on a paper entitled *Multi-Scale Modeling of High Cycle Fatigue of Chopped and Continuous Fiber Composites*. Malo's colleague, Kurt Danielson, accepted a special plaque for excellence in technical writing on his behalf during opening ceremonies at the thirteenth-annual SPE ACCE on September 11, 2013 and presented the paper in the *Virtual Prototyping & Testing* session on September 12 from 8:00-8:30 a.m.

Aside from Malo's current responsibilities as team leader for the engineering services group at e-Xstream, he also is involved in all initiatives at the company on fatigue modeling of composites. He joined e-Xstream in 2009 as a project engineer. Before that, he worked for Rhodia Engineering Plastics on the development of state-of-the-art composite modeling techniques.

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Introduction

Composites are increasingly being used in structural automotive parts, both chopped FRPs as well as CFRPs and hence a clear understanding of composites behaviors is mandatory. This heightens the demand for accurate simulation tools to predict structural performances. In particular, HCF is critically important over these materials as barely visible damage can appear, over the lifetime of a car, in multiple structural parts submitted to small but repeated loads.

Dealing with composite materials, heterogeneous and anisotropic in nature, requires an even better understanding of fatigue phenomena along with rigorous fatigue modeling solutions accounting for their microstructure. The modern metal approaches based on strain based fatigue developed since the 1970's are able to handle plasticity effects especially relevant in the framework of low cycle fatigue problems. However, for HCF problems, more common stress based approaches like critical plane methods are commonly used in the industry. Extensions of stress based approaches to predict polymer fatigue are generally used whereas strain based approaches are more problematic [1] [2]. While standard tests and databases are in place for metals, polymers offer a complex set of challenges that remain to be solved such as fatigue testing methods, proper handling of their anisotropic character and understanding of their sensitivity to mean stress.

Numerous process simulation codes can compute fiber orientation resulting from the manufacturing process such as injection molding, drape molding, compression molding and resin transfer molding. The microstructure determines the anisotropic character of the material. By interfacing with processing data as well as structural FEA codes, Digimat® software bridges the gap between the process and the structural part performances, offering multi-scale material modeling tools capable of modeling the anisotropic, nonlinear, strain-rate dependent and other specificities of composites in FEA.

The purpose of this paper is to illustrate how multi-scale material modeling can be applied in the field of high cycle fatigue modeling to obtain a state-of-the-art accurate fatigue modeling solution for composites.

This paper first presents the main characteristics of composites submitted to fatigue loadings, focusing more specifically on chopped FRP. Then it describes how their HCF behavior can be modeled thanks to micromechanics and the failure models developed in Digimat® by e-Xstream engineering. Finally it presents the validation study carried out jointly by Toyota Motor Europe and e-Xstream engineering on specimens as well as an automotive oil cooler bracket submitted to fully reversible (R=-1) fatigue loadings.

Fatigue Modeling of Composites

At the microstructural level and under static loadings, various and complex damage mechanisms exist, including debonding at matrix/fiber interfaces, fiber breakage, fiber pull-out, matrix drawing, matrix crazing and micro-cracking, shear cracks, nucleation, growth and coalescence of voids. These mechanisms depend on the fiber nature and their orientation with respect to the applied load.

If a uniaxial load is applied transversely to the main fiber alignment of a short fiber reinforced plastic (SFRP), one can observe debonding and matrix drawing as seen in Figure 1 [3]. If a uniaxial load is instead applied along the main fiber alignment of a SFRP, mechanisms such as debonding at the fiber tips, fiber pull-out, fiber failure, shear crack formation at the fiber interface and void coalescence are observed as shown in Figure 2 [3].

In CFRPs, the failure mechanisms directly depend on the fiber orientation with respect to the applied load. If this angle is less than 5 to 10 degrees, the failure is mainly driven by the fibers via local fiber-matrix debonding (in tension) and via micro-buckling (in compression). The adhesion of fibers to the matrix, as well as the in-plane stresses other than the longitudinal stress, influences these two failure modes. If the angle is greater than 10 degrees, micro-cracking parallel to fibers and fiber-matrix debonding often occur. These damage mechanisms are driven by transverse and shear stresses and often lead to a progressive stiffness reduction. Globally, stresses in HCF problems of CFRP materials are low enough such that the damage in the fibers is negligible, the dominant source of HCF failure being the matrix itself and possibly the interfaces between the polymer matrix and the fibers.

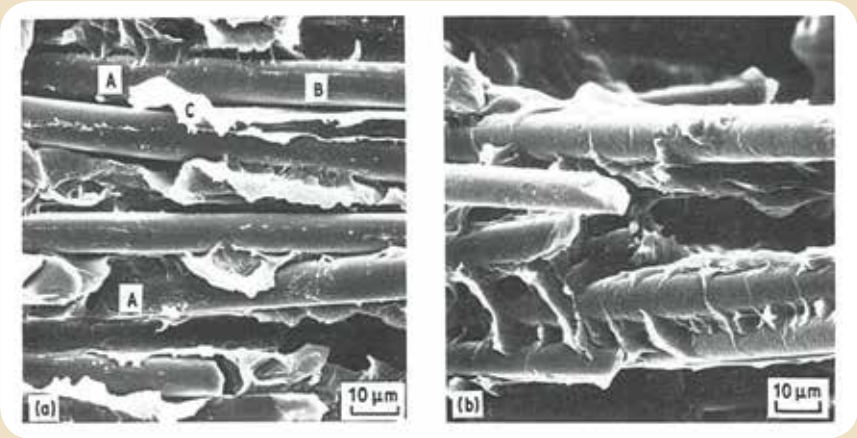

Figure 1. Fractographs revealing failure mechanisms when the load is applied across the main fiber alignment including A. microvoid formation B. extensive debonding C. matrix drawing and b) fast fracture.

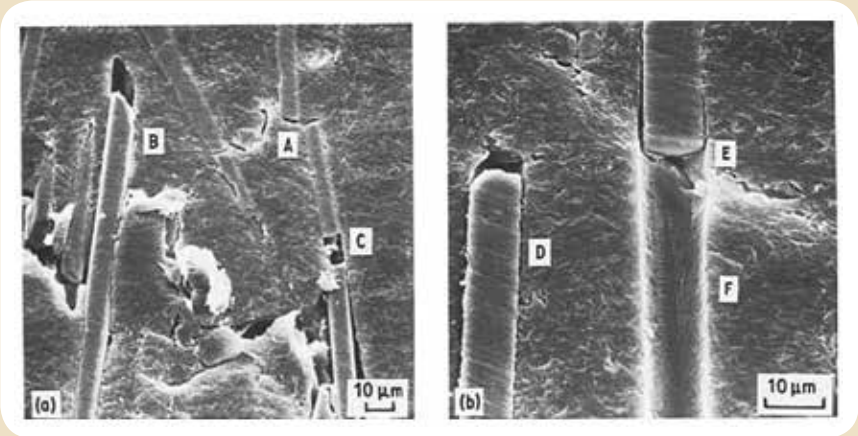

Figure 2. Fatigue damage when the load is applied along the main fiber alignment including A. debonding at fiber tip B. fiber pull-out C. fiber failure D. shear crack formation E. stress concentrations due to sub-surface fibers and F. microvoid coalescence.

FRPs are characterized by a strongly anisotropic character in stiffness. As an extension, the fatigue life of fiber reinforced plastic is also anisotropic and must be characterized by a range of varying S-N curves, with greater fatigue life in the longitudinal than in the transverse direction of the loading to the fibers [4].

To prevent self-heating of polymers, fatigue tests are performed at low frequencies, hence increasing both the testing cost and duration. Some studies investigated means of reducing the amount of tests needed to fully characterize in fatigue a composite. One of the proposed solutions consists in normalizing measured S-N curves by their corresponding ultimate tensile strengths (UTS) which can be measured for the same fiber directions [4], [5]. Such method provides some level of fitting between S-N curves measured at different fiber directions, but is not accurate enough to be predictive within a decade of cycles in fatigue life.

Mean-Field Homogenization Theory

Composites are by definition a combination of two or more constituents to obtain improved material properties 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 with mean-field homogenization techniques. This technique allows computing the anisotropic composite properties based on the properties and the microstructure of the underlying constituents of a multi-phase material. In other words, the original heterogeneous material is represented by an equivalent homogeneous one. Implemented in the Digimat® software [6], this technology has proven to be effective for a broad range of materials.

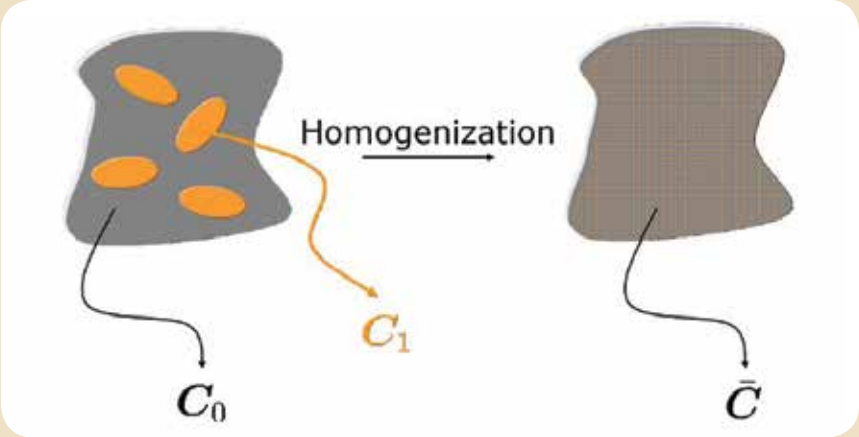

Figure 3: Heterogeneous material (left) from which its equivalent stiffness C is computed from homogenization.

Fatigue Modeling

Ideally, all fatigue damage mechanism would be modeled to ultimately predict fatigue life of composites. At the moment, this is not possible and it would probably involve the execution of a far too large number of tests to identify all the parameters such models would contain. As of today, two routes are proposed to model failure: micro-scale modeling of the damage occurring in fatigue, often focusing on the polymer matrix phase, and macroscopic modeling of the composite fatigue life.

HCF Model for CFRPs

As the fatigue of CFRPs is being primarily driven by the damage occurring in the matrix, e-Xstream implemented in Digimat® a matrix based non-linear fatigue model. It is based on the evolution of damage into the matrix phase, following the two scale scheme proposed by Desmorat et al. [7] for thermo-mechanical composites (Figure 4).

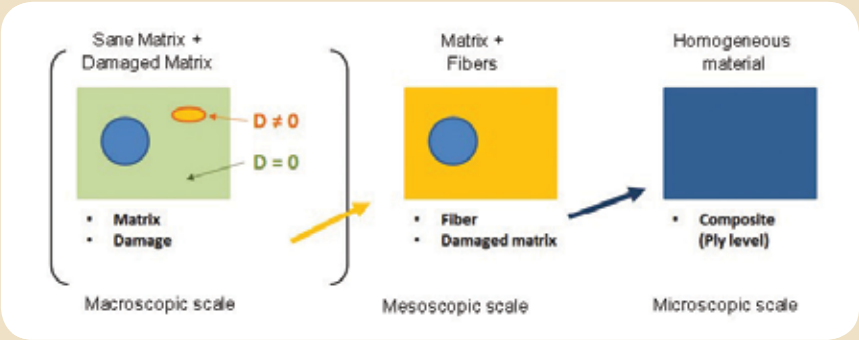

Figure 4: Two-scales damage based fatigue model.

At the microscopic scale, the matrix is decomposed into:

- A sane phase: It plays the role of the embedding medium;
- A damaged phase: It is constituted by local damages appearing in the matrix and modeled as spherical inclusions.

The damaged matrix behavior is described by an elastoplastic law with isotropic damage D. Damage accumulates as plasticity appears, and the fatigue life is determined once a critical damage value, defined by the user, is reached. By considering isotropic damage the "sane" (undamaged) stress tensor $\sigma\mu$ is defined from the damaged stress tensor $\sigma\mu$ with a simple relation:

$$\tilde{\sigma}_\mu = \frac{\sigma_\mu}{1 - D}$$

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Involving plasticity, the whole micromechanical scheme must be iteratively computed at each fatigue load cycle for the prescribed macroscopic stress amplitude, until failure is declared. Such process is prohibitive in CPU time for large numbers of cycles, hence a stepped method is implemented breaking down the logarithmic space of loading cycles into N groups of cycles. Within each group of cycles, the increments of accumulated plastic strain and damage are considered constant and cumulated linearly. However, the increments of accumulated plastic strain and damage are updated upon completion of each group of loading cycles.

Overall a strength of this model is its capacity to handle multi-axial loadings, in comparison to simpler matrix-based failure models based on a kinetic theory of fracture and that are mainly uniaxial [8]. Moreover, it updates the composite stiffness based on the damage accumulating in the matrix. More details about its mathematical description are provided in the Digimat® documentation [6].

HCF Model for Chopped FRPs

Fatigue damage mechanisms in chopped FRPs are numerous, complex and dependent upon the composites microstructure. As a consequence, e-Xstream engineering developed a linear elastic phenomenological HCF model that doesn't explicitly model each damage mechanism individually, but captures them on a macroscopic level.

Multiaxial failure criteria developed for CFRPs, such as Tsai-Hill, have proven to work accurately under static loads; their use can also be extended to compute the fatigue life of composites [9]. These failure criteria account for the dependency of the composite strength on the fiber alignment. The Tsai-Hill 3D criterion was selected to elaborate the phenomenological HCF fatigue model and is expressed as follows:

$$FC(N_c) = \left(\frac{\sigma_L}{S_L(N_c)}\right)^2 - \frac{\sigma_L(\sigma_{T1}+\sigma_{T2})}{S_L(N_c)^2} + \frac{\sigma_{T1}^2 + \sigma_{T2}^2}{S_T(N_c)^2} + \left(\frac{1}{S_L(N_c)^2} - \frac{2}{S_T(N_c)^2}\right)\sigma_{T1}\sigma_{T2} + \frac{\sigma_{LT1}^2 + \sigma_{LT2}^2}{S_{LT}(N_c)^2} + \left(\frac{4}{S_T(N_c)^2} - \frac{1}{S_T(N_c)^2}\right)\sigma_{TT}^2 \quad (1)$$

where

- σ_L denotes the longitudinal stress amplitude,
- σ_{T1} and σ_{T2} the transversal stress amplitudes,
- σ_{LT1} and σ_{LT2} the shear stress amplitudes in between the longitudinal direction and the two transverse directions, and
- σ_{TT} the shear stress amplitude in the plane normal to the longitudinal direction.

The $S(N_c)$ terms refer to the composite's fatigue lives in the different directions with respect to the main fiber alignment, using the same indices. To minimize the number of experimental input, a transverse isotropy assumption, valid for fiber reinforced composites, is applied and leads to handling on three experimental input measurements. The composite fatigue life, under any triaxial stress state, is triggered when the criterion reaches 1.

The application of a Tsai-Hill criterion implies the assumption of uniformly aligned fibers in the composite, which is in opposition with the complex misaligned orientation state that characterizes chopped FRPs. Hence, this problem is solved by an e-Xstream proprietary numerical decomposition of a representative volume elementary (RVE), defined by a complex orientation tensor, into a set of so-called pseudo-grains (PGs). Each PG is by design a two-phase composite simpler than the composite at the RVE level. The solving strategy consists in computing, in each PG, the anisotropic stiffness matrix thanks to the Mori-Tanaka homogenization method and the fatigue life thanks to the Tsai-Hill criterion. Upon computation of these over all PGs, homogenization of the global RVE stiffness and fatigue behaviors is performed.

The HCF model being linear elastic, it is used in combination with the Miner's rule to sum the damage throughout the cyclical loading. The input to this HCF model is three S-N curves measured at different main fiber alignments with respect to the loading direction. The fatigue specimens are thus machined out of injection molded plaques; the typical angles are 0°, 90° and some intermediate angle like 30° or 45°.

The general computation workflow applied by Digimat is summarized in Figure 5.

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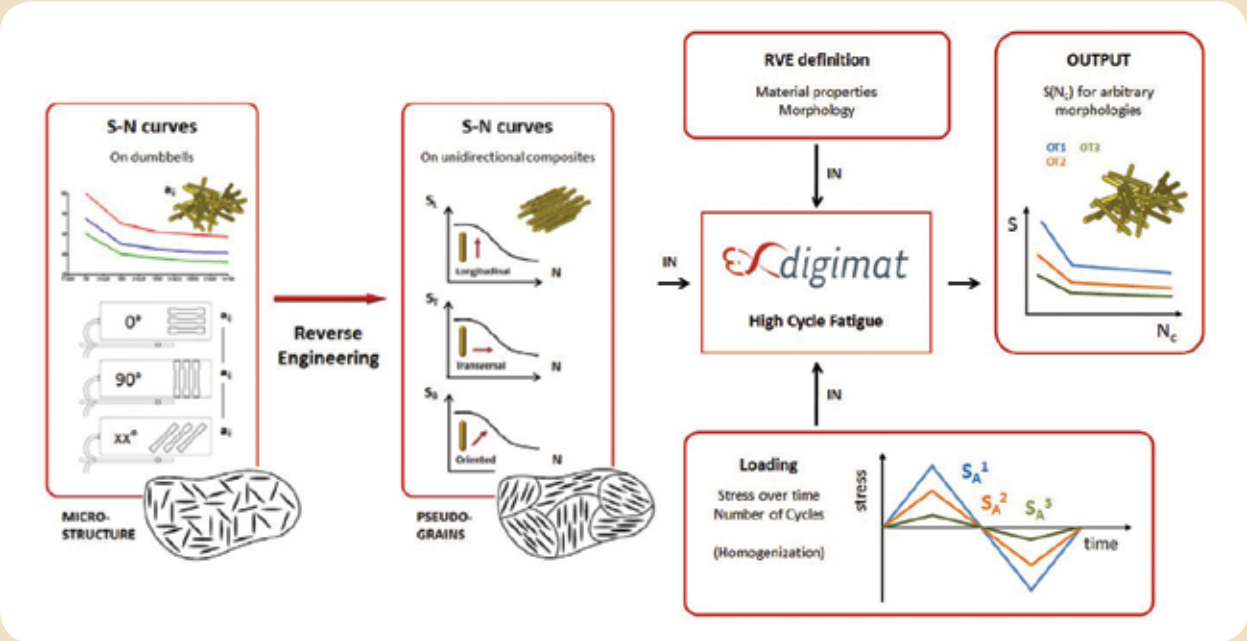

Figure 5: Fatigue computation workflow using the composite PG HCF model.

This fatigue modeling solution is available for standalone computation on one material point (i.e. RVE) as well as in structural interfaces to fatigue codes such as Virtual.Lab Durability and nCode DesignLife; interfaces to FEMFAT and Nastran Embedded Fatigue are under development. The fatigue FE interfaces serve at computing the lifetime prediction of composite parts taking into account the local anisotropic behavior of chopped FRPs.

Validation of the Proposed Fatigue Modeling Technology

e-Xstream engineering collaborated for a long time with Toyota Motor Europe to develop the fatigue modeling technology described above. The developments were validated against uniaxial fatigue specimens and an oil cooler bracket component. The material considered in this validation work is the TECHNYL A218 V35 Black 34NG grade supplied by Solvay Engineering Plastics, nylon 6.6 reinforced by 35% weight fraction of short glass fibers.

Testing Campaign

Two testing campaigns were carried out, one by Axel Products at the specimen level and one by TME at the part level. A focus was made on testing these components under a fully reversible cyclic load involving tension and compression (i.e. R=-1). Specimen buckling is a major risk under such reversible load and must be properly controlled; this was successfully achieved by Axel Products through a precise alignment of the grippers. To avoid self heating effects from the polymer, tests were performed at a frequency of 3 Hz. The test conditions selected are 23°C, dry-as-molded. Nylon is extremely sensitive to humidity. Significant care was brought in controlling the humidity level and maintaining the material dry-as-molded, both by drying properly the specimens in an oven and by storing them in sealed bags with desiccant until testing.

The fatigue test results on the specimen show consistency in the measurements as illustrated in Figure 6, with an emphasis on the fatigue behavior between 1,000 and 1 million cycles. Few data points were measured at 1 million cycles since the S-N curves are relatively flat in that area of the cycling range, meaning that fatigue failure hardly happens. Verifications using strain gauges on both sides of the specimen confirmed that no buckling occurred.

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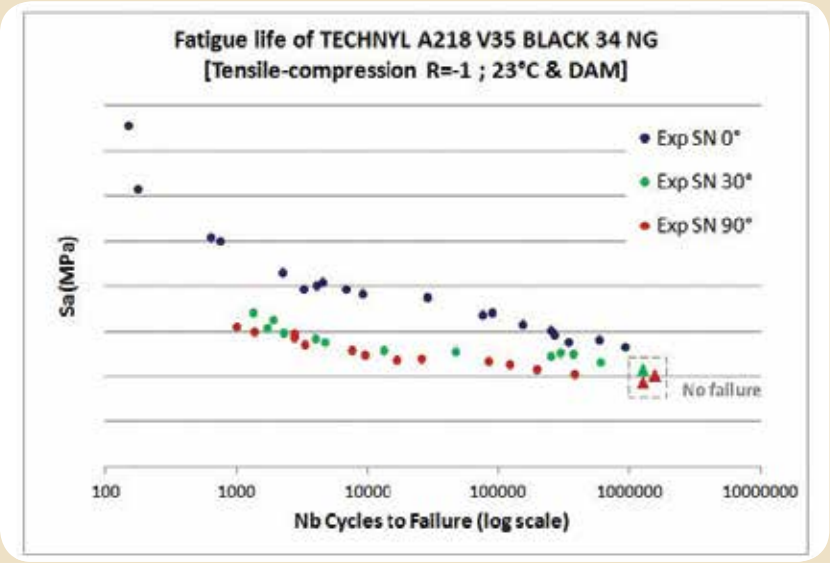

Figure 6: S-N curves measured at 0°, 30° and 90° on the Solvay TECHNYL A218 V35 Black 34NG grade.

At the component level, an out-of-plane reversible load was applied. Damage in the form of cracks was recorded in four different locations. The locations numbering does not relate to the order of appearance of these cracks.

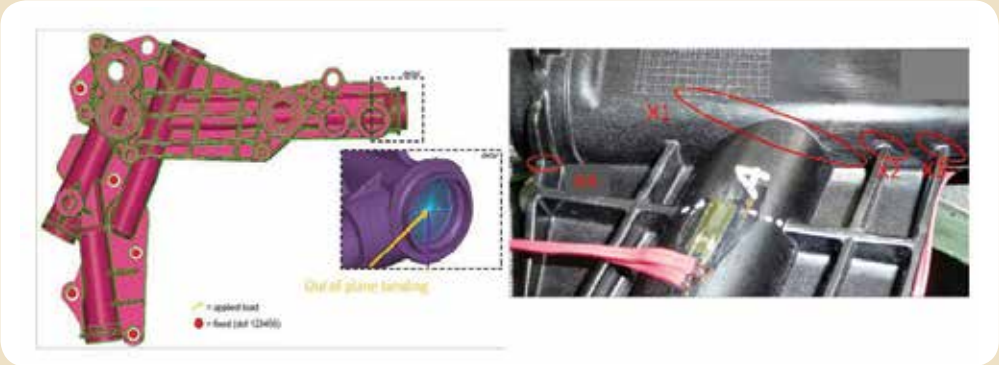

Figure 7: Oil cooler bracket component with indications about the load setup (left); Crack locations recorded during the fatigue tests (right).

FEA Correlation

From the experimental S-N curves measured, a fatigue model was created in Digimat®. The quasi-static (QS) unit load case was computed coupling Digimat® with an implicit FE solver, accounting for the fiber orientation tensor (OT) data computed from injection simulation and mapped onto the structural FE meshes. From these stress results, fatigue FE simulations were performed coupling Digimat® with a fatigue FE solver. In this interface, the Digimat® fatigue model replaces the isotropic S-N model commonly defined in the fatigue software, and Digimat® takes care of computing the S-N local responses in every element of the mesh dynamically throughout the fatigue simulation.

A fatigue computation method called "maximum absolute principal" is selected. This method considers the complete stress tensor, feeding as such the Tsai-Hill 3D criterion used by Digimat®. It is also a computationally cost-effective method in comparison to methods such as the critical plane one. The overall workflow here described is illustrated in Figure 8.

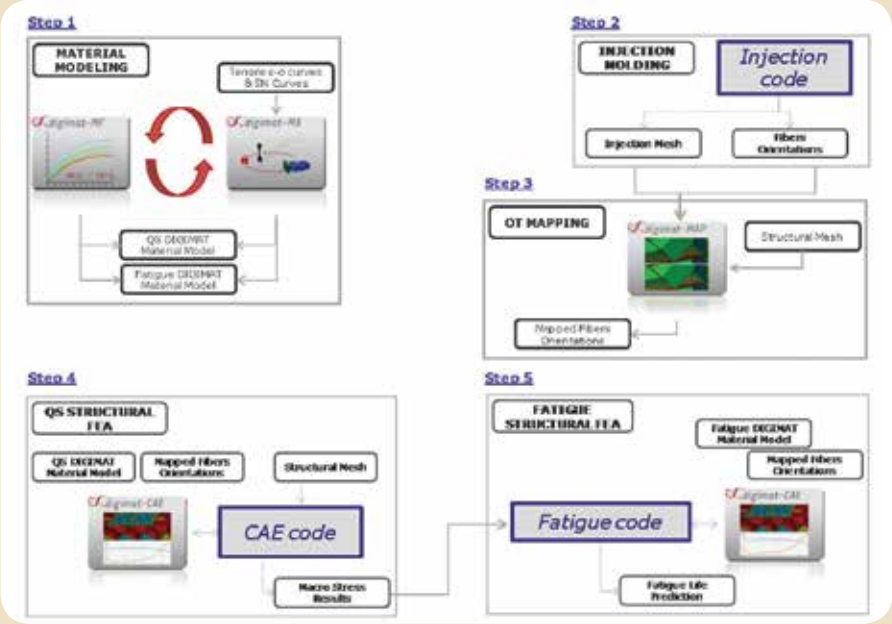

Figure 8: Workflow to numerically compute the fatigue life behavior of a structural part.

The fatigue model was first validated on the numerical FE models of the fatigue specimens. Fatigue life was recorded on the most damaged element of the specimens. This approach is conservative but at the specimen level, fatigue cracks usually propagate quickly (brittle failure). The high cycle fatigue behavior successfully correlates for all three loading angles with respect to main fiber alignment, results being slightly conservative for 30° and 90° angles.

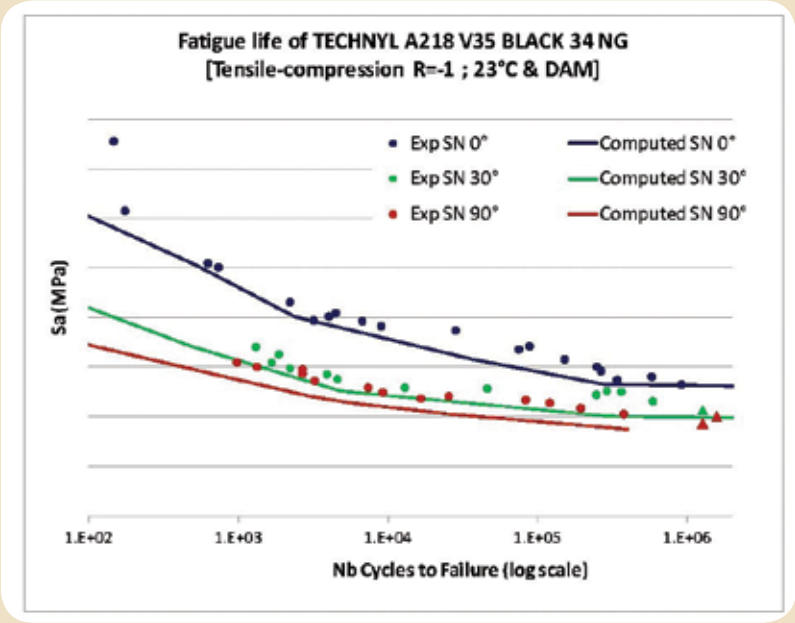

Figure 9: Correlation of the HCF behavior on tensile-compression uniaxial specimens.

The correlation work was then extended to the oil cooler bracket component. The few locations where cracks were experimentally observed are properly identified. The prediction of crack initiation in the most critical rib (location X3) matches the timing at which stiffness reduction was first recorded in experiment as a consequence of local damage occurring in ribs. The experiments, carried out over a larger number of cycles than first crack initiation, lead to large crack propagation in location X1. Though propagation cannot be directly predicted from fatigue simulation since stress redistribution isn't accounted for, fatigue simulation predicts damage occurrence in location X1 and suggest the later occurrence of crack propagation in locations X1, X2 and X4.

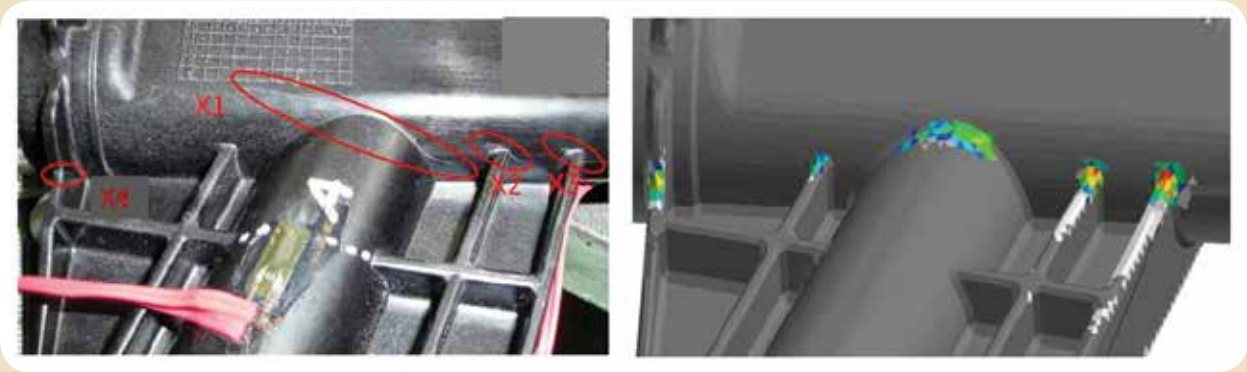

Figure 10: Fatigue life prediction in most critical locations (right) compared to the measured crack locations.

Conclusions

The design of high quality, light and energy efficient vehicles is crucial for success in the automotive industry. The use of composites is essential for achieving that objective and, though very challenging, accurate modeling of their high cycle fatigue behavior is required to optimize designs without compromising the lifetime and security of structural automotive components.

This paper presented two fatigue models developed in the Digimat® software that, combined with mean-field homogenization techniques and the multi-scale modeling approach, accurately predict the high cycle fatigue life of chopped and continuous fiber reinforced plastics. Both models account for the anisotropic character of composites that derive from the composite microstructure, specifically fiber orientation in the resin.

The HCF model developed for chopped fiber reinforced plastics is now available in structural FE simulation coupling Digimat® with fatigue FE solvers. The model was validated on an industrial part from Toyota Motor Europe. It has proven to be accurate both at specimen and part levels. Additional correlation studies are expected on the same fatigue model in the coming months; similar correlation studies, using the damage based fatigue model, will follow on continuous fiber reinforced composites upon identification of partners to help carrying them out.

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COUNCILOR'S REPORT

November 16, 2013 - Council Meeting

Coronado, CA, U.S.A.

Tom Pickett, SPE Automotive Div. Councilor

1. Welcome, Antitrust & Conflict of Interest

SPE President Jon Ratzlaff called the meeting to order at 9:00 a.m. PST, and reminded everyone that the meeting was operating under SPE's Antitrust and Conflict of Interest policies.

2. Roll Call

Determination of Attendance

Secretary Jeffrey Helms conducted a formal roll call for elections and found that 60 sections or divisions were present and 28 were absent; seven proxies with authorized forms were in attendance. Helms made a motion to seat the proxies. The motion was seconded and passed. Helms then stated that a quorum was present to conduct business.

Ratzlaff recognized several attendees and guests: Rick Hays, Suhas Kulkarni, and Ashley Price were special guests assisting with elections and counting ballots. Also, President Ratzlaff recognized the current year Executive Committee, the SPE Staff, and Past Presidents in attendance. Past society presidents in attendance included Len Czuba, Jim Griffing, Lance Neward, and Donna Davis.

Secretary Helms indicated that the roll call was complete.

3. Approval of the Agenda

The agenda was moved, seconded, and passed as published.

4. Approval of Outstanding Minutes

Helms asked if there were any questions on the 2013 Executive Committee minutes of April 18-19, April 22, May 9, June 20, July 2-3, August 15, September 26, and October 24 or the April 22 Annual Business Meeting as presented. There were none.

Helms then requested a motion to approve the Council Meeting minutes of April 21, 2013 as presented. A motion was provided, seconded, and passed.

5. Opening Remarks

Ratzlaff provided remarks regarding the need for members of the SPE governance to focus on delivering value to current and future new global members.

6. Elections

Past-President Jim Griffing chaired the Nominating Committee. He recognized the following nominations committee members: Paul Browitt, Brian Grady, Tim Womer, and Vijay Boolani. The following positions required consensus by ballot: President-Elect, Senior Vice President, Vice President, and Chair of the Council Committee of the Whole (CCOW). These positions rotate or take office at the ANTEC Council II meeting in April 2014.

The following positions are filled through successive rotation at ANTEC: President-Elect Vijay Boolani automatically advances to President; current President Jon Ratzlaff moves to Past President; Past President Jim Griffing will move off the committee; Raed Al-Zu'bi, who was elected last year to a one-year term as Senior Vice President will complete his term in April 2014 and does not plan to run for office this year.

The results of the election were the following: Dick Cameron was elected to the position of President-Elect; Scott Owens was elected as the SPE Senior Vice President; Jamie Gomez was elected to the position of Vice President; Sandra McClelland was elected to the Chair of the CCOW.

7. SPE Strategic Plan 2014-2016

Wim De Vos, CEO, presented an update on the strategic plan for the society. The current structure is not adequate to respond to changes in today's society. De Vos expects to complete the business plan by the end of February 2014.

8. Financials & Budget:

De Vos reviewed the financial performance for October and YTD. As of October 2013 YTD SPE is at an $83.37K loss. Revenues were down because of a lower return from ANTEC. Some international events lost money. Eurotech lost $30K. Expenses were lower on membership mailings but higher on events .There was prepayment of expenses for the China TopCons. Operationally, SPE was over budget by $142K.

De Vos presented a negative budget (-$86K). There were many questions from the councilors on having a deficit budget. De Vos explained that investments are required in order for the society to be profitable in the future. There is a need to invest in infrastructure and regional expansion. A deficit budget will allow the society to spend on the needed infrastructure and regional expansion. There was a motion to reject the budget. The motion was tabled and did not pass. The budget stands as presented.

 Continued from page 41

9. Membership:

Tom Conklin reported an update on membership. The June decline in membership reflects the membership clean up as SPE migrates to an enterprise system. There is a 3.5% decline in membership. SPE plans to change strategy on increasing membership. Going forward there will be less direct mail campaigns. There will be more focus on providing value to members. There will be use of the new internet website, smart-phone enabled conference applications (apps), SPE Social Network, upgrades to the online library, and new global conferences. There is an online join and renew membership process. The website upgrade is planned to be completed by March 2014 with dynamic content, easier access to information, online presence for all member groups, and social networking capabilities. Conklin indicated that Membership Chairs of the Divisions and Sections should remind members to renew, call to welcome new members, and offer packages at conferences to become a member.

10. New Website:

The new website is designed to effectively engage prospective and current members. The Divisions and Sections will be able to manage the content and resources of their own websites as well as restricting content as desired. The new webpage has specific color and bold images. There are tabs for Events, Membership, Leadership, Resources, Communities, and Search.

11. Higher Logic

Mark Lowry, CRO Higher Logic, presented a social media website. He said that Higher Logic is like "LinkedIn® on steroids."

12. New Corporate Identity:

There is a new logo. The new colors (particularly green) appeal to a younger generation. The new logo should be used for new events. The websites, emails, newsletters (digital media) have until end of January 2014 to switch to the new logo. Digital color change over to the new logo is end of June 2014. The hardware (signs, giveaways, etc.) on stock can be used until December 2014.

New polo shirts will be available with the new identity. Black and green polo shirts made from 100% recycled PET bottles are available. Divisions and Sections can order quantities from headquarters for $35 per shirt and sell them to their membership.

13. New Topcon Policy 30

De Vos indicated a mobile app will be available to promote conferences. He explained the policy financials and rules. For conferences with gross sales in excess of $25k, there is a royalty payment of 12% of gross revenue that goes to SPE HQ. SPE HQ will provide support services if desired. There is added SPE HQ insurance as part of the extended services for the event. Limited services are primarily for sites that are far from Newtown, Connecticut, U.S.A. (e.g. India, Dubai, etc.) and also for groups with 1-day event/non-conference with revenues more than $25k that do not requiring registration processes. For those, a 6% of gross royalty payment will be applied. Removed from the gross revenues calculations are the following: tutorial registration, sale of conference proceedings after the conference, $5,000 for scholarships if paid through SPE Foundations. For events with losses up to $10K, a 6% royalty based on conference revenue will be assessed; events with losses greater than $10K will not pay a royalty. Policy implementation will be June 30, 2014. Some council members expressed resistance to royalty based on revenue.

14. Bylaws & Policies Update:

Highlights of some of the Bylaws & Policies were presented.

15. ANTEC-type Conferences Update:

Raed Al-Zu'bi provided an update on ANTEC Dubai. Oliver Crane presented an update to Council on EUROTEC. Vijay Boolani provided and update on ANTEC Mumbai.

16. Committee Reports:

Sections Committee:

Monica Verheij moved that Council approve the merger to form Eastern New England. The motion was approved. Also, Verheij moved that Council approve a new section to be called the ASEAN Section. The motion was seconded and approved. The Council approved formation of the University of Alabama-Birmingham and University of Connecticut -Storrs student chapters.

Next Generation Committee:

J. Gomez presented to Council activities of the Next Generation Committee.

17. Other Old / New Business:

Ratzlaff reported that SPE will recognize innovation in plastics at ANTEC in Las Vegas, Nevada, U.S.A. in April. Division/Section competition winners will be entered in the competition.

18. Adjournment

President Ratzlaff requested a motion to adjourn the meeting. A motion was made, seconded, and passed. The meeting adjourned at 5:02 p.m. PST. Next Council Meeting will be at ANTEC in Las Vegas, April 27, 2014.

SOCIAL REPORT

Teri Chouinard,
SPE Automotive Div. Social Chair

Asahi Kasei Plastics Hosts Successful Student Social Event, Accelerating Careers in Plastics and SPE Membership

Over 80 automotive-engineering professionals, plus students and faculty from five Michigan universities enjoyed an educational and fun SPE Social Event hosted by Asahi Kasei Plastics on February 11. Attendance included 11 students and faculty from Kettering University, 10 from Western Michigan University, 9 from Ferris State University, 7 from Michigan State University, and 3 from University of Michigan-Ann Arbor. The balance of attendees included approximately 20 plastics industry professionals from 10 different companies and 20 Asahi Kasei executives and staff.

The event began with a presentation from the host company about their composites compounding facility and automotive parts and components typically made with their products. The parts that were featured were finalists or category award winners from recent SPE Automotive Innovation Awards Competition and Gala events.

Next was a career-building presentation, including resume and interview tips, and jobs available to engineers in the plastics industry, as well as specific opportunities currently open at Asahi Kasei Plastics. Opportunities presented included entry-level jobs open for college freshmen and sophomores and more advanced and career-specific opportunities for juniors, seniors, and graduates.

After the presentations, plant and lab tours and conversation stations with Asahi Kasei chemists, engineers, sales representatives, and directors followed. The presentations and conversation stations were in Asahi Kasei's parts display room giving guests an opportunity to learn about plastics applications in heavy-truck, furniture, electrical, lawn and garden, power tool, wind power, and other markets.

SOCIAL REPORT Continued from page 43

The highlight of the evening was during dinner when Asahi Kasei awarded an iPad® tablet to Megan Derwich from Western Michigan University for guessing the correct number of resin pellets in a beaker – 17,000! Seven other students, Matthew Baggett and Jarrett Peplinski from Michigan State University, Juan Hernandez from Western Michigan University, Joshua Brown from Ferris State University, Sharna-Kay Dobney from Kettering University, and Scott Zavada from University of Michigan-Ann Arbor also won student memberships in SPE sponsored by Asahi Kasei.

The event concluded with Asahi Kasei president, John Moyer speaking to the students about advancing their careers in the plastics industry and an announcement on the benefits of SPE membership including opportunities for scholarships. Students were encouraged to join SPE and volunteer and make SPE their partner for a lifetime of industry support, success, and friendships.

The purpose of the SPE Automotive Division social events is to provide opportunities for networking, to have fun, and to build membership. Social events will be planned throughout the year, approximately one per quarter, and SPE members will be invited and encouraged to bring a guest who might benefit from participation in SPE. The events will be planned near Detroit-area OEMs and Tier Suppliers to make attendance easy.

If you have an idea for a social event, which may include a tour of your facility or technology presentation or other educational and fun ideas that will interest our membership and entice new members to join, please email teri@intuitgroup.com or call +1.810.797.7242.

TREASURER'S REPORT

by Dr. Jackie Rehkopf

As we start 2014, finances for the SPE Automotive Division remain healthy. As of February 10, we have $23,782 in checking, $27,410 in savings, and $71,977 in PayPal, and another $25,000 is being transferred from PayPal to checking for a total of $148,169 USD.

SECRETARY'S REPORT

SPE Automotive Division Board December 9, 2013 Minutes

Next BOD Meeting: Feb. 10, 2014

ATTENDEES

Yvonne Bankowski	Anthony Gasbarro	Mike Masserant	Suresh Shah
Peter Bejin	Elizabeth Johnston	Tom Pickett	Dawn Stephens
Teri Chouinard	Mark Lapain	Monica Prokopyshen	Steve VanLoozen
Fred Deans	Peggy Malnati	Dave Reed	

The meeting was held at the ACC and via conference call: 5:30 p.m. - 8:08 p.m. August minutes were approved.

ANTEC – Anthony Gasbarro

ANTEC is in Las Vegas, Nevada, U.S.A. from April 28-30, 2014. Suresh Shah is moderator for the Automotive Division session, which has 13 papers, an increase of 5 over 2013.

COUNCILOR REPORT – Tom Pickett

Highlights from November 16, 2013 Councilor Meeting in San Diego, California, U.S.A.

The elections were a big part of the meeting, as was the Business Plan expected to be completed Feb 14. The plan aims to support rapid response to changes in today's society. The SPE headquarters' negative budget garnered considerable feedback. Reasons for the proposed budget include fixing and upgrading infrastructure (e.g. dynamic web content, modern appearance, ease of use, and social networking). President John Ratzlaff focused on providing value to members of a global society to address declining membership (3.5% globally) and losses on international events like Eurotech. The bylaw policy change for divisions and sessions (giving back a portion of proceeds based on gross vs. net revenue) was passed. The new SPE branding was announced Oct. 8th at the Kunststoffe Show in Germany, and the SPE AD implications are summarized under Marcom, below.

EDUCATION – Monica Prokopyshen

The student community service credit criteria and purpose were discussed. New suggestions will be incorporated into the next draft of the document. Elizabeth Johnston volunteered to participate in the 2014 Explorathon®, March 26, 2014

BOD MEETING – Yvonne Bankowski

Neil Fuenmayor and Parashar Davé expressed interest in joining the board. Elias Shakour of the Center for Automotive Research (CAR) was elected as Division Vice-Chair. Peter Bejin joined the board of directors.

MARCOM – Peggy Malnati

Branding: SPE AD was the first group fully compliant with the new SPE corporate identity requirements. This required new fonts, a new shield, and new colors, as well as changes to print and web publications. As a courtesy, the SPE AD updated logos for the Detroit Section, plus Composites and Thermoset Divisions.

2014 AutoEPCON: Ads appeared in 2013 ACCE and IAG Program Guides and the call for presentations fliers were produced for email and print distribution.

2013 ACCE: (Preliminary Numbers)

- 68 paying sponsors, 66 exhibitors (sold out) up from 55 in 2012
- 902 registered attendees, up from 636 in 2012
- 92 30-minute presentations (including 7.5 hr tutorials), up from 77 presentations (including 2.5 hr tutorials) in 2012
- Net Income before distribution: $72,415.79 USD up from $57,657.85 in 2012. *With the bylaw change, the distribution to SPE HQ will change to12% of gross proceeds (sponsorship & registration) instead of 30% of net income before distribution.*
- Projected Distribution: HQ $21,725.04; Comp. & Auto. Divisions $25,345.88 each.

2014 ACCE: Date: Sept. 9-11
Tagline: *Composites: Meeting Today's Automotive Needs*

The new artwork, banner, and call for papers flier are complete and the website and many forms have been updated. Michael Connolly is the Event Chair and Antony Dodworth the Assistant Chair.

2013 IAG: The fifth press release (Winners) was distributed Nov.6 and pre- and post-event ads are running with publishers.

The 60-page guide and awards module were released Nov. 6th

As of Dec. 9th, $14,000 in duplicate trophies have been sold using the new web order fulfillment process. The photographic team was excellent.

2014 IAG: Peggy Malnati will establish dates that Burton Manor has available.

SPE AD Website: August set another all-time monthly traffic record for the SPEAutomotive.com website of 55,163 unique hits/month.

SPE AD Newsletter: The 52-page December issue features a new column, *Service through Science*, bylined by the Detroit Section's Adrian Merrington. Rhoda Miel of Plastics News answers the popular question: "How can We Place Higher in the Innovation Awards?" in the Batter's Box column. Elizabeth Johnston is the guest columnist for *An Engineer's Life*, and discusses work / life balance and career changes that satisfy her many passions. Other stories include the ACCE wrap-up and a technical article by an ACCE Best Paper winner.

SECRETARY'S REPORT

Continued from page 45

Misc. Marcom: Finalize swap agreements with event chairs and send to magazines. Update the retractable banner(s) with the new SPE logos. Reprint *Engineer's Life* and *Service through Science* columns. Currently newsletters containing the articles are distributed to students by Monica and Margie, but reprints would be less expensive, require less storage space (short fliers versus 40-50 page newsletters) and could be used for student chapters and for other student events conducted by the Automotive Division and Detroit Section. Cost sharing with the Detroit Section and HQ will be explored as well as a storage solution with more convenient access for these publications.

MEMBERSHIP – Steven VanLoozen

Membership increased 28% to 1,048 during the period from Aug. 5, 2012 to Nov. 1, 2013 and was reported in the December newsletter. New Membership Chair, Steven Van Loozen discussed plans to survey current and lapsed members to determine the value proposition of SPE AD membership will get underway in January to inform division programs. As of January 7, 2014 the membership committee comprised: Steven Van Loozen, Ron Price, Fred Deans, Teri Chouinard, and Elias Shakour.

SOCIAL – Teri Chouinard

Building on the successful SPE AD social event held recently at the Buick Gallery | Sloan Museum in Flint, Michigan "*Corvettes from Zero to 60*," which was attended by students and faculty of Kettering University and SPE members, the next social event planned is a plant tour of Ashai Kasei's compounding facility in Fowlerville, Michigan, U.S.A. The networking event is open to SPE members and those interested in SPE. Kettering, Ferris State, and Michigan State University students have expressed interest in attending this event.

TREASURER'S REPORT – Jackie Rehkopf

As of Nov. 24, 2013 the SPE AD balance was $186,959.66 with no outstanding bills (reported in December newsletter).

NEW BUSINESS

The Pinnacle and Communication Award submissions are due December 31, 2013. Vince Holmes is coordinating the Pinnacle submission and Peggy Malnati the Communication award submission.

2014 BOD Meetings: Feb 10, April 14, June 16

The board approved a motion for software for 3 concurrent users and Comerica bank fees to set up a system to allow electronic fund transfers (EFTs) from sponsors whose companies ban PayPal access. *(Customers with PayPal access can pay by credit card. PayPal costs the division $360/yr and the eBlast & registration system costs $630.)* The multiuser software enables EFT via QuikBooks Pro to the bank. The estimate is $100 (software) and $180 (bank fees).

Suresh Shah offered a 3-D printer to SPE for education purposes.

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