



AUTOMOTIVE PLASTICS News

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



MARCH 2013
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SPE® AutoEPCON Tackles Today's Most Pressing Global Automotive Mandates

by Terrence Q. Cressy

In its eighth year, SPE's Automotive Engineering Plastics Conference (AutoEPCON), co-organized by the SPE Detroit Section and Automotive Division, will offer more than 24 technical presentations on new developments in engineering plastics, four top name keynote speakers, exhibits from dozens of suppliers, and ample networking opportunities in three concurrent sessions. All this, plus breakfast, lunch, and a reception are packed into this unique one-day engineering materials conference on Tuesday, April 30, 2013 at the MSU Management Education Center (<http://mectroy.com/>) in Troy, Mich.

focused on *Advances in Design Engineering, Predictive Engineering and Analysis; New Materials; Processing and Enabling Technologies; and New Application Development.*

The conference will have nearly 30 sponsors, attendees from most of the OEMs and Tier 1s that have a North American manufacturing and technical presence along with leading material suppliers. Attendance this year is expected to exceed 300 people.

Opportunities remain to give a technical presentation, sponsor, and/or register to attend. Key contacts include:

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The conference theme, "*Meeting Global Mandates with Engineering Plastics,*" captures the urgency that exists to increase component quality and performance at lower final costs against a short timeline to comply with fuel economy, emissions, and safety regulations worldwide, according to Kathy Minnich, senior manager for materials at Ford Motor Co., who also is executive chair of AutoEPCON 2013.

Confirmed keynote speakers include Eric Fediwa, director of Powertrain Forecasts at I.H.S., and Alan Taub, recently retired as GM global vice-president of R&D and now professor and leader of a new center for the development and manufacturing of advanced lightweight materials at the University of Michigan in Ann Arbor. Currently scheduled sessions will be



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AUTOMOTIVE DIVISION MEETING SCHEDULE & SPECIAL EVENTS CALENDAR



Auto. Div. Board Meeting

American Chemistry Council - Auto. Ctr. 5:30 - 7:30 pm
Troy, MI USA April 8, 2013

8th-Annual SPE Automotive Engineering Plastics Conference (AutoEPCON)

MSU Management Education Center ALL DAY
Troy, MI USA April 30, 2013

Auto. Div. Board Meeting

American Chemistry Council - Auto. Ctr. 5:30 - 7:30 pm
Troy, MI USA June 10, 2013

Auto. Div. Board Meeting

American Chemistry Council - Auto. Ctr. 5:30 - 7:30 pm
Troy, MI USA August 12, 2013

13th-Annual SPE Automotive Composites Conference & Exhibition (ACCE)

Diamond Center ALL DAY
Novi, MI USA Sept. 11-13, 2013

15th-Annual TPO Automotive Engineered Polyolefins Conference

Troy Marriott ALL DAY
Troy, MI Oct. 6-9, 2013

Auto. Div. Board Meeting

American Chemistry Council - Auto. Ctr. 5:30 - 7:30 pm
Troy, MI USA Oct. 28, 2013

43rd-Annual Innovation Awards Gala

Burton Manor 5 - 11
Livonia, MI Nov. 6, 2013

Auto. Div. Board Meeting

American Chemistry Council - Auto. Ctr. 5:30 - 7:30 pm
Troy, MI USA Dec. 9, 2013

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

<http://speautomotive.com/ec>

Call Jeffrey Helms at 248.377.6895 for more information.



CHAIR'S MESSAGE

Jeffrey Helms



The Automotive Division

has spent the first 2 months of the year hard at work on our 2013 events. Our spring season begins with the annual SPE ANTEC meeting in Cincinnati, Ohio at the Duke Energy Convention Center on April 22-24. The Automotive Division will have one technical session followed immediately by our annual business meeting. All members are welcome to attend and spend a few minutes with our on-site Automotive Division board members. Additionally, we welcome any of our members who would like to join our board and help participate in serving our members to contact us and get involved.

Immediately after ANTEC, the Automotive Division and Detroit Section will hold the 8th-annual Automotive Engineering Plastics Conference (AutoEPCON). This year's event will be held on April 30th at the Michigan State Management Education Center in Troy, Michigan. The theme of this year's conference is *"Meeting Global Mandates with High-Performance Plastics"*. The automotive business continues to globalize and I would imagine that nearly all of the SPE Automotive Division membership is affected in their work by engineering standards and regulatory mandates defined and established in differing regions. While the standards among countries and regions are similar, they are not the same. Even global vehicle designs must have the ability to incorporate local requirements and customer wants in a cost-efficient manner, and engineering plastics have an important role to play in meeting these sometimes-divergent requirements. We expect this year's AutoEPCON event to be very well attended, so please register as soon as possible to make we have a seat ready for you.

Three other major events are also in the planning stage for later this year.

- The 13th-annual Automotive Composites Conference and Exhibition (ACCE, jointly sponsored with the Composites Division) is scheduled for September 11-13, 2013 at the Diamond Center in Novi, Michigan. The theme of this year's ACCE is *"Composites: Lightweighting the Cars of Tomorrow."* Attendance and exhibits at last year's ACCE were our largest ever, so we've had to move to a larger facility after 12 years. With tighter fuel economy and tailpipe emissions requirements pending in many geographies, we expect interest in composites as an enabler for vehicle weight reduction to be even greater this year.
- The 15th-annual SPE TPO Automotive Engineered Polyolefins Conference (Auto TPO) will be held October 6-9, 2013 at the Troy Marriott. This year's theme is *"TPOs: Driving Value, Light Weight and Innovative Automotive Solutions."* While this show is not formally organized by the Automotive Division, many of our members both participate on the planning committee as well as attend, so we thought you might want to put it on your calendar.
- The 43rd SPE Automotive Innovation Awards Gala will be held on November 6, 2013 at Burton Manor in Livonia, Michigan. Last year we had record attendance for this event. Please start thinking about your nominations for this year's competition. The nomination deadline is September 1, with first round judging beginning in late September.

Planning is also underway for social/networking events for our membership around the Southeastern Michigan area. Teri Chouinard is our Division Social Chair and is currently planning events for 2013, including tours of plastics production, part production, and/or vehicle assembly plants. Our December event was held at the Walter P. Chrysler Museum on the Chrysler Tech Center grounds. Approximately 40 people came out to take a last look at the classic vehicle collection before the doors closed to the public. If you are a car nut and couldn't be there, you really missed a close-up look at a collection of true classics. More information regarding all of our technical and social events is available on our website, www.speautomotive.com. Please join us when, if and as often as you can.

Sincerely,

Jeffrey Helms

2012-2013 SPE Automotive Division Chair
2012-2013 SPE Automotive Innovation Awards Competition & Gala Chair
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BATTER'S BOX

Guest Columnist

Will carbon fiber be ready to join the 54.5-mpg battle?

*By Lindsay Brooke, Senior Editor,
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If ever there was a cause for bold thinking in the way light-duty vehicles are engineered and constructed, it's the latest round of U.S. Corporate Average Fuel Economy regulations. And with the new CAFE, the opportunity for carbon fiber to finally break into mainstream use has arrived. But will the strong, lightweight material and the processes needed to make it cost competitive be ready?

CAFE calls for a 99% improvement in each automaker's fleet fuel efficiency through 2025, compared with 2011. For an industry that prides itself on squeezing single-digit efficiency gains from its products, achieving a 99% leap forward — 54.5 miles / gal (mpg) — in less than four product cycles from today will take a Herculean effort. The daunting goal will be toughest for those full-line makers with larger pickup trucks and utilities, the most frugal of which currently eke out 25 mpg on the highway.

As SPE members know, vehicle mass reduction is one of the strategic pillars in the drive to 54.5. Product planners want to reduce vehicle curb weights by up to 750 pounds without sacrificing the size and functionality customers love—and without raising cost significantly. It's a tricky feat. It requires new materials and new processing solutions, some of which already are appearing on the technology roadmaps of those full-line companies.

For the materials industries, the new CAFE regs are heating up competition like it was the 1980s again. Back then the plastics industry was mustering an all-out blitz on steel's dominance. Plastic-bodied concepts headlined auto shows. Plastic fenders and liftgates were replacing their steel counterparts on production cars. And GM was launching plastic-bodied space-frame architectures for the *Pontiac Fiero*, the U-body "dust-buster" minivans, and the multi-billion-dollar *Saturn* program.

The plastics industry pushed hard and gained marketshare, while it scrambled to resolve quality issues related to the thermal-expansion coefficients of some materials. But as hard as plastics pushed, Steel responded to the threat by rolling up its sleeves and pushing back harder. Instead of allowing themselves to be swept under the tsunami of PC/ABS, MPPE/PA, and SMC, the steelmakers innovated. They revamped

manufacturing processes and brought new and lighter alloys to production. Most importantly, they worked with their customers on holistic, cost-saving processes.

It was a call-to-arms level of focus. Steel's effort became a case study in how an industry sector can respond successfully to a competitive challenge. For the march toward 2017-2025 CAFE, it appears the aluminum industry will challenge steel as the primary material for automotive body structures and exterior panels. The boldest example of this is Ford's decision to switch its bread-winning *F-Series* pickups to an aluminum-intensive body and cargo box in 2015.

It will be a costly and somewhat risky move. But what other available material can enable significant mass to be shed while meeting the manufacturability, crashworthiness, repairability, long-term durability, cost, recyclability, and sheer throughput requirements (60 jobs per hour!) of a mainstream vehicle program?

This is where I would cue the drum roll and trumpet fanfare for carbon fiber and advanced composites, but the band isn't yet ready to sound those tones. When will it be, then? Recent progress has made me cautiously optimistic that carbon fiber's decades-long promise beyond specialty applications may indeed be realized in time to help OEMs meet CAFE 2025.

My view comes from what's happening on the front lines of CF development. The collective work is aimed at dramatically scaling-up the capability to serve automotive volumes with robust products, improved process technologies, and lower materials cost.

At their joint-venture plant in Moses Lake, Washington, BMW and SGL have made a \$100-million bet that carbon-fiber-intensive vehicle structures, initially for BMW's 2014 *i3*, are indeed ready for prime time. (The facility and its managers





Batter's Box CONTINUED FROM PAGE 5

made a quite positive impression on me during a recent visit.) In Walker, Michigan, Plasman Carbon Composites' new 200,000-ft² facility has begun mid-volume (40-50,000 units/year) production of CF parts for the 2014 *Corvette Stingray* with a new process technology that dramatically shortens machine and curing cycle times.

And at the U.S. Department of Energy's Oak Ridge National Labs in Knoxville, Tennessee that has led carbon fiber R&D in the U.S. for years, projects to develop low-cost precursors based on kraft lignin (a by-product of papermaking), commodity-grade PAN as a precursor, to reduce precursor conversion costs using microwave energy-generated plasmas, and to slash equipment costs and precursor-oxidation time, are ongoing and promising.

The expanding list of pre-competitive industry collaboration is encouraging, to say the least. Indeed, it's getting easier to count the global OEMs who aren't working together on carbon fiber projects than to count those who are. Besides BMW and SGL, Toray is working with Toyota, Fuji Heavy Industries, and Daimler while its major Japanese competitor, Teijin, has a venture with General Motors. Ford and Dow-Aksa are partners. Audi is working with Voith, the third-largest shareholder in SGL, of which VW owns a minor share. There's even a deal between Lamborghini, Quantum Composites, and Callaway Golf.

Perhaps more remarkable, there's CALM—the Coalition of Automotive Lightweighting Materials. Formed last year with support from the American Chemistry Council and the Aluminum Association's Aluminum Transportation Group, CALM combines the strengths of the aluminum and composites/plastics industries with technology providers in design, fabrication, and joining. Their collective goal is to support OEM efforts to reduce vehicle weight.

Whenever I air the words "carbon fiber" among industry engineers, the high cost of the raw material gets the greatest play. It's difficult to talk about CF's many attributes when its average price of \$12 or more per pound compares with about \$2.50/pound for aluminum and about a buck a pound for typical high-strength steels. But solutions for narrowing that delta are coming at a faster rate, industry leaders tell me.

"Our goal is to match the cost of aluminum, and we're not yet there," Dr. Joerg Pohlman, SGL Automotive's managing director, said during my visit to Moses Lake. "But we foresee the day in the next few years where we can match aluminum's cost in a full vehicle body structure."

If Dr. Pohlman's vision is realized, carbon fiber may play more than a minor role in the CAFE battle.



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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

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An Engineer's Life... *Tom Russell*



Some of us come to engineering, especially plastics engineering, in a most unlikely way. Today it seems like it was inevitable, as I am a co-owner of a business that primarily consults in the area of plastic composite technology. But that career path wasn't on my radar when I began my professional career.



I come from a small town in Pennsylvania where I didn't know any engineers. I have an uncle who is a chemist, and I think he was the one who influenced me to look at science or engineering as possible career. When I applied to Penn State, mechanical engineering sounded like it was right up this inveterate tinkerer's alley, and I discovered that it was. When I graduated, the job market was in one

of its periodic slumps, so I decided to go to graduate school at Caltech. That's where I met a recruiter from Ford, and how I got to Michigan.

My first close encounter with plastics came early in my career at Ford. I was the product engineer on an integrated grille opening and reinforcement panel that was molded in SMC. This was also my first exposure to SPE, as the part won the 1979 SPE Automotive Grand Award for *Most Innovative Use of Plastics*. During my time at Ford, I managed to complete my MBA at the University of Michigan by attending their evening program, and when I graduated I decided to get more involved in the plastics world.

I had noticed that the resin suppliers were doing the most innovative work on plastics applications, so I got a job as an engineer with GE Plastics (now SABIC). This was a wonderful place to develop my skills, and I took advantage of the opportunity by working in engineering and marketing, as well as a couple of joint-venture companies. Getting involved in a joint venture really tests one's ability to navigate different cultures, where you may not understand all of the rules, but you still have to get the job done. It can be frustrating and fun at the same time, but I found it to be a great experience.

Eventually, I decided that I needed experience at a Tier 1 supplier, and I joined a molder called Automotive Industries, which was acquired by Lear Corp. a few years later. During my time at Lear, I further expanded my background by taking jobs in consumer research, Six Sigma, sales and R&D. I even had a stint as vice-president of product engineering in the electrical division. Then, in 2007, I left to co-found our consulting business.

That's a lot of different assignments in different companies, so what's the overriding theme to this story? Well, like any building project, a career starts with a good foundation, and I got that by relentlessly pursuing technical and business education. But I added to that foundation by taking on a wide variety of assignments and always looking for new areas to expand my knowledge.

My materials background came largely through on-the-job training, and I always wished I had taken more of those courses when I was in school. I'm not sure how I could have anticipated that when I was younger, but I've always managed to find people who could teach me the basics, and then I've used my education and training to bring myself up to speed.

Today, I consider myself to be very lucky to be using nearly all of the skills I've acquired over the years. When you become an entrepreneur, you quickly come to realize that you need to perform all of the functions that make the business run, from accounting



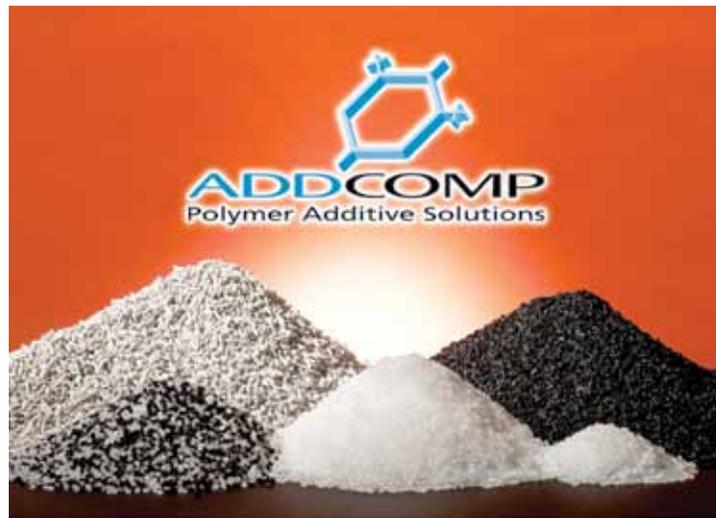
An Engineer's Life CONTINUED FROM PAGE 8

and marketing to research, engineering, and program management. Composites are a highly technical area, and we spend a lot of time doing basic engineering and costing calculations to demonstrate that an idea is feasible. These can't be done without a technical and business background. Of course, we can perform more sophisticated analysis, but we often find that a quick hand calculation will save a lot of time and money before serious resources are deployed.

So my job today is like a capstone class for my career, and I continually discover that things I had had a fleeting association with in the past are now a big part of my professional life. When I started in the automotive world, *steel was king*, but I got an off-the-wall assignment to make a plastic front end for a truck. It turned me towards my present career, and I'm grateful that I was given that opportunity. I think Yogi Berra said it best: "When you come to a fork in the road, take it." To me, that's a winning philosophy and the way I try to live my engineer's life.

Tom Russell

Tom Russell, P.E., is currently chief-executive officer of Allied Composite Technologies, LLC. He has over 30 years of experience with leading manufacturing enterprises, and has an extensive background in plastic materials and processes. For 15 years, Russell was employed by the Lear Corporation, one of the world's largest automotive suppliers. At Lear, he held the positions of vice-president of Advanced Engineering - Interior Products Division, vice-president of Interior and Electronic Advanced Products, vice-president of Product Engineering for Electrical and Electronic Products, director of Advanced Sales, director of Six Sigma Deployment, director of Consumer Research and Analysis, and director of Research. Prior to joining Lear, Russell spent a decade at GE Plastics where he held a variety of engineering and marketing management positions. He began his career at Ford Motor Company as a product engineer. Russell holds a Master of Science degree in Mechanical Engineering from Caltech, an MBA degree from the University of Michigan, and a Bachelor of Science degree in Mechanical Engineering from Penn State University. He is a member of several professional organizations, a Registered Professional Engineer, and holds a U.S. patent.



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ANTEC CHAIR'S REPORT

Anthony Gasbarro



Hello, 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.

This year, ANTEC will be held at the Duke Energy Convention Center in Cincinnati, Ohio from April 21-24. You can find more information at www.4spe.org.

The Automotive sessions will be held on Wednesday, April 24th. We currently have 8 papers scheduled to be presented as well as a keynote speaker. There will be a morning session and an afternoon session. The exact times are not yet established. However, right after the last paper is presented in the afternoon we will hold our Automotive Division annual meeting and I hope to see many of you there. In fact, I'd love to see some additional support from our Automotive Division members down in Cincinnati.

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

Thank You

Anthony Gasbarro

Anthony Gasbarro

Below is the currently planned Automotive technical session for the 2013 ANTEC.

Advances in Automotive Plastics Driving Fuel Economy

Keynote Speaker (*to be determined*)

Lightweight Fastening Solutions for Thermoplastic Material

Paper # 1537652 | Joseph Gobernatz, ATF Inc.

DELTA PT® ALU overview covers secure and reliable direct assembly into thermoplastics. This aviation-industry accredited high-strength aluminum material, offers lightweight designs (with weight savings compared to screws made of steel), optimized heat treatment for strength properties and corrosion resistance, non-magnetic anodization for different colors, and coefficient of expansion adapted to the component material.

Sandwich-Structured Thermo Plastic Olefin Resin for Light Weight Automotive Bumper Fascias Enables Molding by a Conventional Injection Molding Machine

Paper # 1561368 | Kazuhisa To, Mazda Motor Corp.

A high stiffness, thermoplastic olefin (TPO) resin material has been developed for lightweight automotive bumper fascias. Most conventional TPO materials for automotive bumper fascias consist of three components: 1) polypropylene, 2) elastomer and 3) filler. However, this newly developed TPO consists of 5 components: 1 & 2) two kinds of polypropylene, 3 & 4) two kinds of elastomer, and 5) filler. The composition in this TPO was designed to enable sandwich-structure molding by a conventional injection molding machine. This TPO has not only a much higher modulus, but also has better flow-ability when compared to conventional TPOs. By using this TPO for automotive bumper fascias, wall thickness can be reduced from 2.5 mm to 2.0 mm while maintaining equivalent performance. The new material, together with sandwich-structure molding, achieves a weight reduction of approximately 20%. Moreover, in the bumper production process, thinner walls reduce cooling time, shortening the molding cycle by about 50%. As a result, the bumper molding time can be reduced from 60 to 30 seconds, leading to major reductions in the amount of energy consumed in the production process.



ANTEC Chair's Report CONTINUED FROM PAGE 10

Predication of Weld Joint Long-Term Strength Under Creep Conditions

Paper # 1579886 | Alexander Chudnovsky, University of Illinois at Chicago

Based on failure analysis of glass reinforced polyamide (PA) weld joints, this paper proposes a thermodynamic model for weld joint lifetime using continuum damage mechanics and Eyring kinetic equation for damage growth. It presents the formulation of the model, and uses the accelerated test data to estimate basic parameters: activation energy and activation volume of fracture. The model also is validated by comparing its predictions with a relatively low temperature test data.

FEM Simulation of Brittle Damage Features Developed During Scratch

Paper # 1590143 | Mohammad Hossain, Texas A&M University

Brittle damage features, such as crazing and cracking, formed on polymer surfaces during scratch are to be avoided if at all possible. Successful simulation of the evolution of these deformation processes would allow for deciphering the fundamental mechanics involved and for establishing correlation between the material/surface properties and the brittle damage features induced during scratch. In this work, attempts are made to simulate microcrack formation in the scratch groove. The FEM simulation results show good agreement with experimental observation reported in the literature.

Development of a Process Technology for High Volume Production of Thermoplastic Composites Based on Hybrid Rovings

Paper # 1561505 | Roman Schöldgen, Institute of Plastics Processing (IKV) at RWTH Aachen University

Continuous fiber reinforced thermoplastics are increasingly used for lightweight construction parts due to their relatively easy processing. Yet a cost effective use for structural components is still limited due to the absence of an appropriate and economic high volume production technology. Therefore, a new process technology for the production of lightweight parts within short cycle times is being developed at the Institute of Plastics Processing (IKV) at RWTH Aachen University. This paper presents first results of the research on the process technology based on fiber spraying and consolidation of preforms made of chopped hybrid rovings.

Development of a Foaming Technology to Produce Polyurethane Molded Foam Parts Using CO₂ as Blowing Agent

Paper # 1561534 | Simon Latz, of Plastics Processing (IKV) at RWTH Aachen University

The existing technologies to foam polyurethane (PU) in a discontinuous molding process show several disadvantages regarding achievable foam properties. At the Institute of Plastics Processing (IKV) a physical foaming process has been developed that allows foaming of PU molded parts using CO₂ as a blowing agent. Two different methods that enable a controlled dissolving process of CO₂ out of the reaction mixture, and consequently a homogenous cell structure, have been investigated.

Reliability of Weld Joint Under Fatigue Conditions

Paper # 1591660 | Alexander Chudnovsky, University of Illinois at Chicago

This paper focuses on reliability of glass-reinforced polyamide (PA) vibration welded joints with respect to fatigue. It presents a statistical extension of the thermodynamic model of lifetime under creep into a reliability model under creep and fatigue. The paper also presents in detail a method of obtaining Weibull distribution parameters employed in the model. The proposed reliability analysis can be easily implemented for weld joint design.

Flowability Software for Powder Produced by Raleigh Disturbances for SLS

Paper # 1628566 | Andreas Prager, University of Wisconsin

Powders for additive manufacturing processes such as selective laser sintering (SLS) are currently produced by costly cryogenic milling or precipitation processes for a limited selection of resins. A novel technique allows production of pellets in the micrometer-scale by extruding a polymer melt through a capillary and perturbing it with a hot air stream, which can be used for the SLS processes. Due to the fact that this micropelletization process is used to produce powder particles from different materials, the developed software is very helpful to predict the flowability of these different particle shapes and different materials and its usage for the SLS process. This software will determine the flowability characteristics of different grain shapes and will be evaluated by comparison of results provided by both, software and experimentation. In a second step, different micropelletized materials' surface smoothness' will be compared and evaluated towards their competitiveness. This validation will show a comparison of quality and performance between the different powder production processes. The goal of this work is to produce more cost-effective but competitive powders out of different micropelletized materials.

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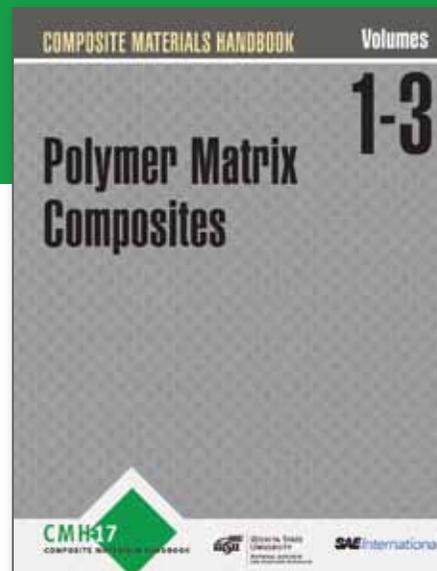
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SPE® Auto TPO Conference Organizers Announce 2013 Event Dates, Issue Call for Papers & Presentations

The fifteenth-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 6-9, 2013**. This year's theme is TPOs: Driving Value, Light Weight, & Innovative Automotive Solutions. The organizing committee also has issued its annual call for papers, with **abstracts due April 19, 2013** and non-commercial **papers or presentations by July 31, 2013** (eMail both to TPOpapers@auto-tpo.com).

Bill Windscheif, president, Advanced Innovative Solutions, Ltd. and conference co-chair notes, "A few years ago we made the strategic decision to expand our event's coverage beyond just rigid and flexible thermoplastic polyolefins (TPOs) to include flexible thermoplastic elastomers (TPEs) and thermoplastic vulcanizates (TPVs). We clearly saw the role of these materials expanding among automakers, plus their functionality constantly being improved upon by resin suppliers and compounders. We've also featured sessions for many years on improving molding productivity and designing better parts because we know that engineering and manufacturing need to work closely to improve first-pass yield. We work hard to scout the industry each year to find the most interesting and innovative technologies to include in our conference. Attendees tell us over and over that the practical knowledge they gain is why they return every year. They know their time won't be wasted and they'll leave with lots of new ideas and great new contacts, thanks to the event's outstanding networking opportunities."

Conference co-chair, Jeffrey Valentage, global market planner-specialty compounding automotive, ExxonMobil Chemical Company adds, "With the increased focus on improved fuel economy, interest in lightweight, high-performance TPO materials is stronger than ever. Last year's conference broke our all-time attendance record and we expect the same thing to happen in 2013."

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** managed by Patti Tibbenham, Ford Motor Co. and Neil Fuenmayor, LyondellBasell; **Rigid Polyolefin Compounds** managed by Mike Balow, Asahi Kasei Plastics North America and Ermanno Ruccolo, Mitsui Plastics, Inc.; **Automotive Interior Trim & Skins** managed by Dave Helmer, General Motors Co. and Yvonne Bankowski, Ford Motor Co.; **Surface Enhancements** managed by Dr. Rose Ryntz, International Automotive Components and Jim Keller, United Paint Co.; **Automotive TPEs** managed by Bob Eller, Robert Eller Assoc., Inc. and Jeff Valentage, ExxonMobil Chem. Co.; **Tooling & Design of TPO Parts** managed by Dave Okonski & Charles Buehler, General Motors Co.; **Molding & Forming of TPOs** managed by Hoa Pham, Avery Dennison Corp. and Dr. Suresh Shah, SPE; **Lightweighting of Polyolefin Parts** managed by John Haubert, Chrysler Group LLC and Charles Buehler, General Motors Co.; and **Adhesives & Coatings for TPOs** managed by Dr. Pravin Sitaram, Haartz Corp. and Dr. Laura Shereda, Inteva Products LLC.

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 approximately 500 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 *SPE Detroit Section*.

For more information, see www.auto-tpo.com
or <http://speautomotive.com/tpo>

SPE® Announces Dates, Location, Theme for 13th Automotive Composites Conference & Exhibition (ACCE)

The organizing committee for the *SPE® Automotive Composites Conference & Exhibition (ACCE)* today announced the dates, theme, and location for this year's show and issued its annual Call for Papers. Now in its thirteenth year, the SPE ACCE is the *world's leading forum for automotive composites* and draws exhibitors, speakers, and attendees from 15 countries on five continents. This year's show, whose theme is *Composites: Lightweighting the Cars of Tomorrow*, returns **September 11-13, 2013** but to a new venue.

Creig Bowland, senior research associate at PPG Industries, 2013 SPE ACCE conference co-chair explains, "Our conference has been fortunate enough to enjoy excellent growth the past few years ☐ so much so that we have literally outgrown our home of 12 years. We and management at our previous venue tried everything we could to make the most of the space we had, but it became clear during last year's ACCE that we needed to make a change. We've moved our 2013 conference to **The Diamond Center** (<http://diamondbanquetcenter.com/>), which is part of the Suburban Collection Showplace in Novi, Mich., U.S.A. We believe it will give us the best of both worlds ☐ the friendly, intimate feel of our old facility and the flexibility to grow and spread out that we so badly needed.

Adds conference co-chair, Antony Dodworth, managing director, Dodworth Design, "It'll be great to have all our exhibitors together in a single room for the first time since 2007, and this facility is still convenient to major highways in the Detroit area. In fact, a brand-new hotel is being built adjacent to the Diamond Center and that will make the show even more convenient for out-of-town guests."

Those interested in speaking at this year's event should submit **abstracts** by **March 29, 2013** and full **papers or presentations** are due **May 31, 2013** to the review committee via ACCEpapers@speautomotive.com. Authors who submit 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.

ABOUT THE SPE ACCE

Held annually in suburban Detroit, the ACCE draws over 650 speakers, exhibitors, sponsors, and attendees and 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 OEM, and another 25% representing tier suppliers. Attendees also represent 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://compositeshelp.com>.



TREASURER'S REPORT

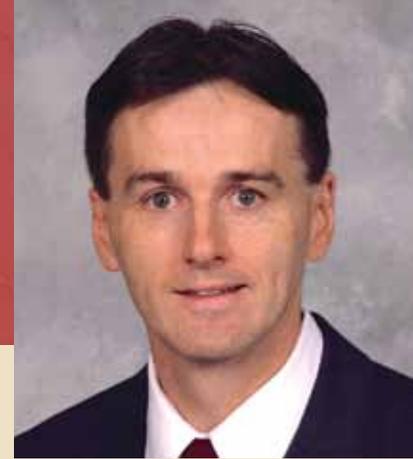
Jackie Rehkopf

The SPE Automotive Division finances are in excellent standing due to early sponsorships for our 2013 ACCE and IAG events. We have \$190.1K in checking, \$27.4K in savings, and \$57.1K in Paypal ready for transfer to our bank account. We have a total of \$274.6K as of Feb. 11, 2013.



COUNCILOR'S REPORT

December 5, 2012 - Virtual Council Meeting
Tom Pickett



1. WELCOME, ANTITRUST & CONFLICT OF INTEREST

President Jim Griffing called the meeting to order at 10:02 a.m. Eastern U.S. Time, Wednesday, December 5, 2012, and reminded everyone that the meeting was operating under SPE's Antitrust and Conflict of Interest policies.

President Griffing made preliminary remarks outlining some of the guidelines for this meeting.

2. ROLL CALL AND SEATING OF PROXY

Secretary Al-Zubi determined that the following proxies were present.

SECTION/DIVISION:	PROXY:
Blow Molding	Lew Ferguson
Flexible Packaging	Paul Waller
Lehigh Valley	Larry Ingram
Ontario	Jaesun Suh
Pioneer Valley	Mark Berry
Southern	Jamal El-Hibri
Thermoset	Greg Spaeth

Secretary Al-Zubi made a motion to seat the proxies. The motion was seconded and passed.

It was noted that there were 54 participants in the meeting. Secretary Al-Zubi indicated that a quorum was present for the transaction of business.

President Griffing recognized this year's Executive Committee members:

Past President, Russell Broome
President-elect, Jon Ratzlaff
Sr. Vice President, Dick Cameron
Treasurer, Greg Campbell
Secretary, Raed Al-Zu'bi
Vice President, Bill Arendt
Vice President, Vijay Boolani
Vice President, Olivier Crave
Vice President, Jeff Helms

President Griffing acknowledged SPE's Past Presidents who were in attendance: Ken Braney, Lance Neward, Bill O'Connell, Len Czuba, and Vivian Malpass.

President Griffing acknowledged SPE staff members that were in attendance: Gail Bristol, Tom Conklin, Sarah Sullinger, Sue Wojnicki, and Wim De Vos.

President Griffing acknowledged as guests Ms. Monika Verheij, Chair, Council Committee of the Whole, and Dr. Sadhan Jana.

Secretary Al-Zubi indicated that the roll call was complete.

3. APPROVAL OF THE AGENDA

It was moved, seconded and passed to approve the agenda as published.

4. APPROVAL OF OUTSTANDING MINUTES

Secretary Al-Zubi asked if there were any questions on the 2012 Executive Committee minutes of September 13, 2012, as published and distributed. There were none.

Secretary Al-Zubi made a motion to approve the September 15, 2012, Council Meeting minutes as published and distributed. The motion was seconded and passed.

5. 2012 BUDGET STATUS AND PROJECTION:

SPE CEO De Vos updated the participants on Society's year-to-date (YTD) figures as of the end of October. Some of the highlights included a total net result of \$264K which is composed of \$260K Foundation results, \$195K financial growth of the Society's investment account, and a negative operational result of \$190K. Total revenue YTD stands at \$2.4M compared to a budgeted \$2.6M. This variance is due to reduced revenue from membership. Revenue from events and publications is above the YTD budgeted figures.

In terms of Expenses, most line items are below budget such as operational, membership, and events with a resulting YTD figure of \$200K less than budget (i.e. \$2.4M vs. a budgeted \$2.6M figure).

SPE CEO De Vos reminded participants of the decision made at the last Council Meeting to correct the error in the 2012 rebate calculation, an additional \$50K expense, and its impact on final results. It is now projected that the Society will finish out the year between negative \$17K and negative \$100K as an operational result. As a whole, the positive performance of the investment account and the Foundation fund should give a positive overall year-end result.

SPE CEO De Vos noted the expected positive impact of ANTEC Mumbai on performance. The sponsorship budget has been surpassed, and all indications are that the Society will make a profit from ANTEC Mumbai.

6. REVIEW & APPROVAL OF THE 2013 BUDGET:

Treasurer Campbell made a motion to accept the 2013 budget as published and distributed. The motion was seconded. Treasurer Campbell gave an on-line presentation of the 2013 Budget with the following budget highlights:

- Projected positive year-end net income of \$12K.
- Projected membership figure of \$13.5K with corresponding membership revenue of \$1.35 Million. These projections are based on 2012 results.

Councilor's Report CONTINUED FROM PAGE 16

- Projected revenue from ANTEC registration of \$600K and from exhibits of \$375K.
- Projected total 2013 revenue of \$3.77M.
- Major category expenses include \$305K for membership, \$250K for rebates, \$45K for opening the society's China office, an increase in travel expenses of \$40K, depreciation costs increasing by \$40K due to software upgrades, and a payroll increase due to an SPE staff raise.
- Projected total 2013 expenses of \$3.76M.
- It was noted that in 2013, the society will be responsible for PlastiVan program income and costs.

Treasurer Campbell addressed a number of questions regarding the 2013 budget and associated assumptions. This was followed by a vote on the motion to approve the 2013 budget. The motion passed.

7. BYLAWS & POLICIES:

Bylaws & Policies Committee chair, Len Czuba presented two bylaws amendments for second reading.

Bylaw 3.1 Society Policies:

This bylaw change allows the Executive Committee – as well as the Council – to establish, maintain, and eliminate policies. It also indicates that if a conflict exists between a policy established by the Council and one created by the Executive Committee, the Council policy shall prevail.

Motion: To approve the amendments to Bylaw 3.1 as presented. The motion was seconded and approved with 47 in favor and 3 opposed.

Bylaw 16.2 Rules Procedures and guidelines:

This bylaw change adds the Executive Committee to this bylaw relative to the groups that may establish, annul, or amend Policies, Rules, Procedures and Guidelines.

Motion: To approve the amendment to Bylaw 16.2 as presented. The motion was seconded and approved with 49 in favor and 2 opposed.

Policy 002 Rebates, Procedure for Calculating:

Chair Czuba noted that this change requires only one reading and a vote. This change will simplify the way rebates are calculated. Currently the process to join SPE online is complex and takes a long time. The proposed change to Policy 002 eliminates Primary and Secondary Sections and Divisions, and proposes a flat fee rebate structure as follows:

- For Sections: A \$15.00 flat fee rebate, with a base payment of \$300 for smaller sections with under 150 members. Calculations based on this change are financially very close to the current calculation and would bring higher rebates in 2013 for most sections.
- For Divisions: A \$5.00 flat fee rebate for divisions, with no base payment. Calculations based on this change are financially very close to the current calculation and should satisfy all divisions.

Motion: To approve changes to Policy 002 as presented, second made and discussion regarding this change ensued.

Motion: To modify the original motion to state that Policy 002 should list a percentage instead of the flat fee. The motion was seconded and discussion ensued. This motion was defeated.

A vote was held on the original motion. It carried with 40 in favor and 8 opposed.

Chair Czuba recognized members of his committee for their hard work and contribution. Also recognized were members of staff assisting the committee in its work.

8. OPERATIONAL PLANNING COMMITTEE:

Chair Scott Owens updated participants on the latest regarding this committee's work. He gave a presentation detailing their work on simplifying and streamlining minimum group requirements (criteria). A detailed discussion ensued on the information provided in this presentation.

Chair Owens requested feedback from participants on the committee's revised minimum criteria that will make it in line with Policy 002 (items b through f below), and asked for Council support to allow them to continue along the presented line. This request is not a formal vote.

- Define BOD (Officers): In progress currently with EC
- File paperwork required by government bodies annually
- Submit Financial Reports to Central Office annually
- Submit Operating Plan to Central Office annually
- Be represented at at least half of the Council meetings
- Communicate with group members at least 3 times per year

9. SANCTIONS AND EMBARGOS:

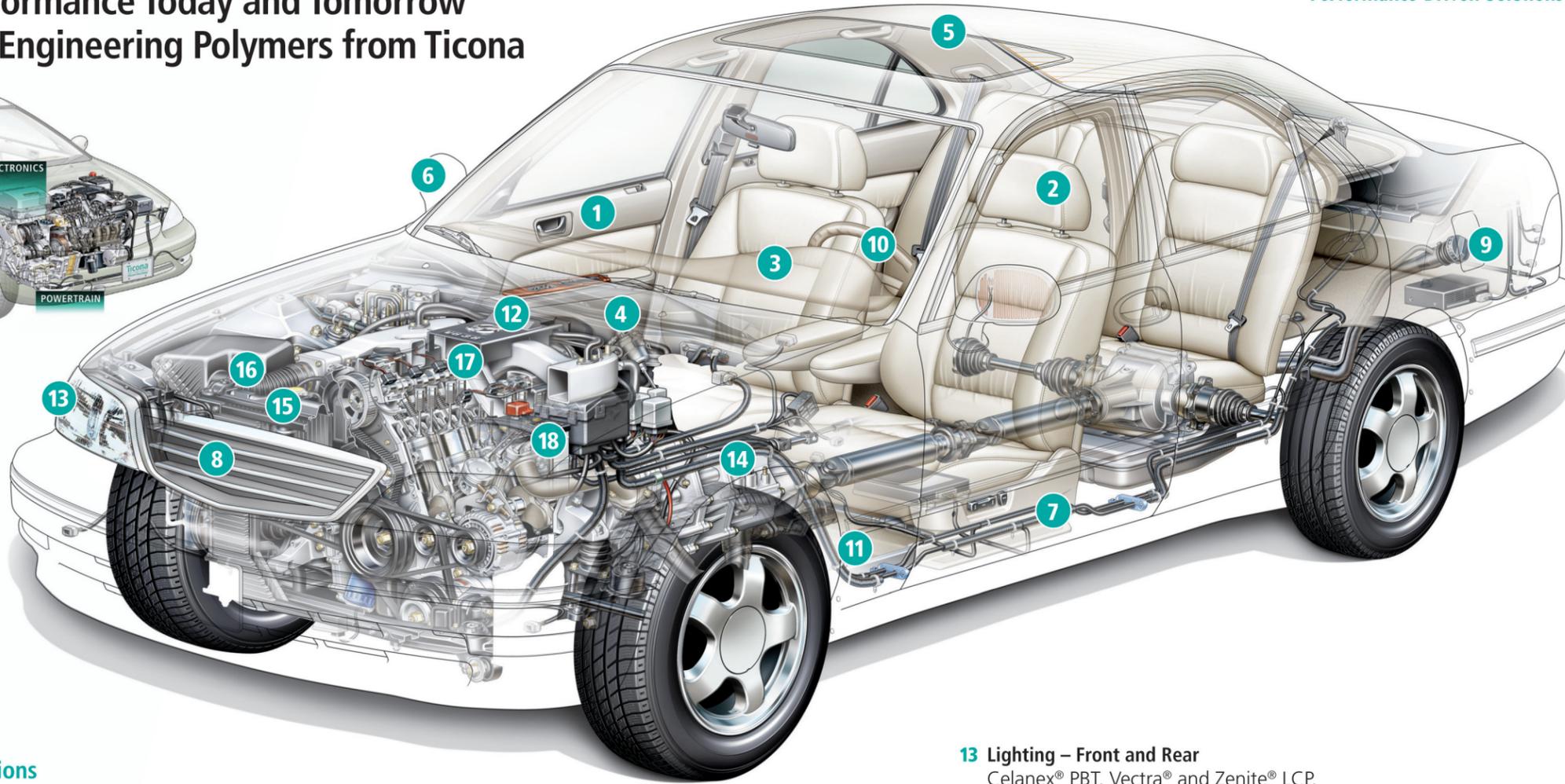
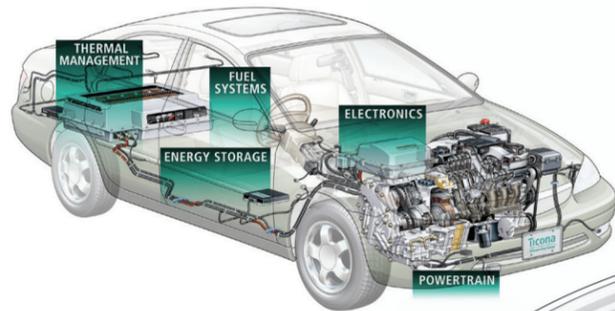
President Griffing updated participants on the latest with regards to this subject, noting that the society addresses this matter in Policy 021. The Executive Committee believes that we are in compliance, but has requested legal feedback to ensure we are compliance regarding sanctioned countries. It is expected that EC will have a final position to report to Council at the next meeting.

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14 Powertrain – Transmission

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15 Powertrain – Water Management

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16 Powertrain – Air Management

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17 Powertrain – Engine

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Benjamin Hangs, Manfred Reif & Frank Henning
Fraunhofer Institute for Chemical Technology (ICT)

Andreas Martsman, *Oxeon AB*
Simon Tage Jespersen, *Fiberforge*

The following technical paper (in slightly abbreviated form) was a 2012 *SPE Automotive Composites Conference & Exhibition (ACCE) Best Paper Award* winner in the Advances in Thermoplastic Composites category. The paper was one of three that received the highest points during peer review at the 12th-annual SPE ACCE by a panel of expert readers. The paper describes a study conducted by organizations in Europe and North America that looked at methods to increase stiffness/strength and impact resistance of thermoplastic composites by using continuous-strand, unidirectional-glass (UD) tapes to produce woven fabrics as well as tailored blank laminates. Combinations of the tape fabrics and the tape laminates in various layup patterns were then used in conjunction with charges produced in the direct-long-fiber thermoplastic (D-LFT) inline compounding (ILC) process to compression mold both test plaques and later an actual automotive underbody-shield part to determine the extent to which impact performance was improved and to ensure cycle times were consistent with automotive production requirements.



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ABSTRACT

With strong pressures to reduce carbon emissions and improve fuel economy for passenger vehicles and commercial trucks in most geographies, interest in composites by transportation OEMs is growing. As a result, suppliers of composite materials are working to improve thermo-mechanical performance, increase processing speeds, reduce part mass and costs, enhance surface aesthetics with fewer post-mold operations and generally make it easier to position composites against high-strength steel and aluminum. To that end, a study conducted by organizations in Europe and North America last year looked at methods to increase stiffness/strength and impact resistance of thermoplastic composites by using continuous-strand, unidirectional-glass (UD) tapes to produce woven fabrics as well as laminates. Combinations of the tape fabrics and the tape laminates in various layup patterns were then used in conjunction with charges produced in the direct-long-fiber thermoplastic (D-LFT) inline compounding (ILC) process to compression mold both test plaques and later an actual automotive underbody-shield part to determine the extent to which impact performance could be improved.

TECHNIQUES TO BOOST MECHANICALS OF D-LFT COMPOSITES

In 2011, Ticona Engineering Polymers¹, Oxeon AB², Fiberforge³, and Fraunhofer Institute for Chemical Technology (Fraunhofer ICT)⁴ decided to work together on a joint study to evaluate techniques to boost the mechanical properties of D-LFT composites with a PP matrix. The approach was to use the tailored D-LFT process and two forms of UD-glass reinforcement, which were produced from continuous-strand, UD-glass tapes produced by Ticona and subsequently formed into a plain-weave tape woven fabric by Oxeon or into a UD tailored blank/laminate by Fiberforge. Use of UD-glass tapes are already well recognized in the composites industry for boosting stiffness/strength of composite materials. Ticona's glass tapes in higher temperature matrices are already used in the commercial aviation market for a variety of thermoplastic components. Hence these tapes provided a logical starting point for the study. Oxeon is an experienced converter of spread-tow reinforcements (UD tapes and 0/90 & ±45 fabrics) from a range of different materials, utilizing their novel Spread Tow- and Tape Weaving technologies, and thus was the perfect partner to produce woven fabrics based on the UD-glass tapes. Fiberforge has patented a process for converting preimpregnated thermoplastic tapes like those produced by Ticona into UD laminates with tailored fiber orientation (called Tailored Blanks, but hereafter referred to as tape laminates), which are used to boost the mechanical performance of thermoplastic composites. And Fraunhofer ICT is a fully equipped R&D center with significant expertise in the field of polymer composites. In fact, Fraunhofer ICT, in conjunction with Dieffenbacher GmbH Maschinen- und Anlagenbau⁵ helped co-develop the D-LFT process in the early 2000s and then helped develop the tailored D-LFT process in the mid-2000s.

STUDY OVERVIEW

The main study consisted of two distinct phases.

In the first phase, pure D-LFT charge, pure tape-based fabrics, pure tape-based laminates, and then various hybrid combinations of 2 or 3 materials in different layups were laid up in a simple 400 x 400-mm flat test plaque tool and compression molded. After demolding, a number of standard test specimens were waterjet cut from each plaque and were subjected to *EN ISO 6603-2 "Determination of Multiaxial Impact Behavior of Rigid Plastics – Part 2: Instrumented Puncture Test"* [12]. The generous size of the test plaque allowed enough samples (6 total) to be cut from a single plaque to do all the testing planned while reserving 1 of the 6 as a control. The simple geometry allowed for very rapid evaluation of numerous combinations of materials and layup patterns so researchers could quickly evaluate results and determine the best-performing candidates.

As part of the first phase of testing, with the hybrid-material plaques, to reduce influence of sample prep on the results obtained samples for impact testing were cut from both the pure D-LFT as well as tape-fabric or tape-laminate side of the plaque.

In the second phase of the study, researchers used the knowledge they gained from molding the various combinations of pure and hybrid materials in the plaque tool to come up with a specific combination of all 3 materials that they felt would work in a more complex part – an approximately 1,100 x 800-mm automotive engine noise shield (generously loaned to study participants by Minda Schenk Plastic Solutions⁶). This was an excellent application to assess the commercial viability of tailored D-LFT since it was a real production automotive tool. It was a more demanding design to fill than the flat test plaques because it had segments of tall, thin ribs and other design features that UD-glass products would have a hard time penetrating. The tool did offer researchers a couple of challenges, although these turned out to be relatively easy to overcome. First, since it was designed to mold standard D-LFT, it was not equipped with clamps/ fixtures that could be used to hold tape fabrics or tape laminates in place and prevent their movement during forming. This necessitated precutting the UD-tape-based products to end-shape dimensions and manually positioning them in-

¹ Florence, KY, USA and Sulzbach, Germany

² Borås, Sweden

³ Glenwood Springs, CO, USA

⁴ Pfingztal, Germany

⁵ Eppingen, Germany

side the cavity prior to press closure. Although problems were anticipated, the manual placement method worked well. In addition, since this was a real production tool meant for continuous operation, there were no heating lines installed, so no way to heat the tool other than to keep molding hot material. During the time when the hybrid parts were produced and molded, the tool was kept warm ($\approx 40\text{-}45\text{C}$) by molding pure D-LFT parts, which exit the ILC process at close to 200C . Since the goal of the engine-shield molding trial was to evaluate if the tailored D-LFT process was fast enough for commercial automotive production, no further testing was done on the hybrid shield parts.

MATERIAL INPUTS

The base D-LFT material used in the study was inline compounded using resin (PP-C711-70 RNA) supplied by Dow Chemical, an additives package (Priex⁷ 20078 coupling agent for improved impact performance and AddVance 453 stabilizer) supplied by Addcomp Holland BV; and glass fiber (JM 490 2400 tex glass) supplied by Johns Manville. For the plaque tool, glass loading for the D-LFT charge was 30 wt-%, which is the most common automotive loading level for D-LFT materials. However, owing to the complexity of the engine shield tool, a glass loading level of 20 wt-% was used to enhance fill.

A ZSE-60 GI500 32D inline compounding system was used in combination with a ZSG-75 HP300 mixing extruder (both from Leistritz Extrusionstechnik GmbH⁸) and a dosing unit from Brabender⁹ GmbH & Co. KG¹⁰. The ILC system was supplied by Dieffenbacher and coupled to the company's 36,000-kN Compress Plus DCP-G 3600/3200 AS hydraulic compression press equipped with parallel leveling control¹¹.

For the UD-glass based products, the starting prepregged tapes (Celstran¹² CFR-TP PP-GF70 with 70 wt-% glass supplied by Ticona) were 0.25-mm thick, and were supplied slit to various widths depending on what was being done with them.

In turn, Oxeon used the tapes to produce plain-weave TeXtreme¹³ fabrics that were 0.50 mm thick per layer in either a $0^\circ/90^\circ = (0/90)$ or a $\pm 45^\circ$ configuration = (± 45) . These fabrics were supplied unconsolidated.

Ticona's tapes were also used by Fiberforge to produce Tailored Blank/tape laminates. Laminates destined for flat plaque molding trials were laid up in several different patterns: a $0^\circ/90^\circ$ configuration = $(0/90)$ in a single preconsolidated sheet whose final thickness was 0.5, 1.0, 1.5, or 2.0 mm; or a quasi-isotropic configuration = $(0,90,+45,-45)_s$ where "s" represents number of layers of laminate symmetry. For the engine-shield molding trials, Fiberforge made both generic laminates for manual cut-out as well as Tailored Blanks (consolidated laminates with geometry cut to match tool geometry, thereby reducing scrap) to show the enhanced design options possible with tailored products.

PURE AND HYBRID LAYUP CONFIGURATIONS

To quickly determine the effect of using UD-tape products to alter the mechanical properties of the base D-LFT material, for the first phase of testing, 21 different pure material and hybrid material configurations were attempted and 20 were successfully produced in the flat plaque tool. The 11 most representative configurations are shown in Table I below. A single plaque was produced for each configuration, and then test coupons were removed and subjected to instrumented puncture impact testing as noted previously. The ability to produce a large number of test combinations quickly and then evaluate their performance helped researchers understand the combinations that yielded the best results.

6 Esslingen, Germany

7 Priex and AddVance are registered trademarks of Addcomp Holland BV.

8 Nuremberg, Germany

9 Brabender is a registered trademark of Brabender GmbH & Co. KG.

10 Duisburg · Germany

11 The latter feature is particularly important to guarantee global accurate thickness in parts when molding materials like D-LFT. Even if a charge is placed off center in the tool, the press will compensate (by pushing deeper into another section of the charge) so that final part thickness will be uniform across the part. Given the speed at which compression presses typically operate, especially with short cycle-time thermoplastics, the presses are required to have extremely accurate and responsive parallel leveling control.

12 Celstran is a registered trademark of Ticona Engineering Polymers.

13 TeXtreme is a registered trademark of Oxeon AB.

Technical Paper CONTINUED FROM PAGE 22

Based on what was learned in the flat plaque molding trials, for the second phase of the study with the engine-noise shield, researchers selected a new hybrid materials combination that they felt would work best in this tool. Since this tool was larger and more complex, researchers wanted to understand how the various materials moved/flowed in the tool, especially since it was not equipped with clamps/fixtures and researchers were still concerned the UD-tape products might move significantly during the molding process. To evaluate material movement, Ticona supplied precolored UD tapes as well as a color masterbatch for the D-LFT material. Coloration was used as follows: the D-LFT charge was **blue**; the tape fabric was **black**; and the tape laminate was **yellow**, as shown in Figures 1a, 1b, & 1c and 2a & 2b and also in the color-coded rows in Table I (rows in **green** represent hybrid materials combinations).

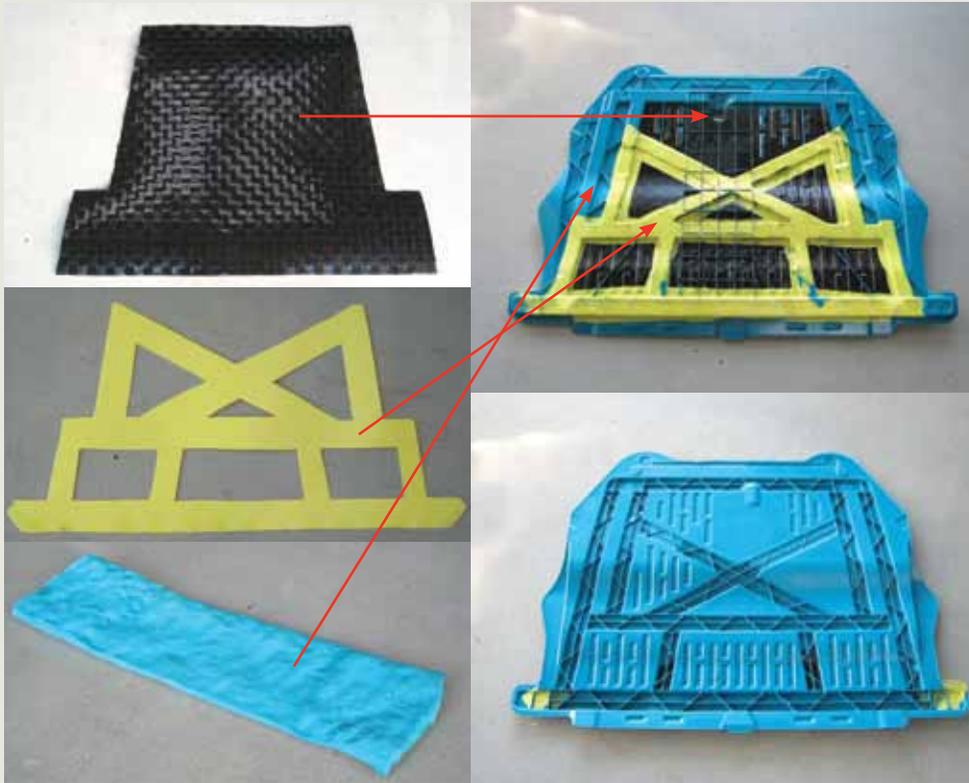
OVEN PREHEATING PARAMETERS

In both studies, to ensure good adhesion between the D-LFT charge and the tape fabrics or tape laminates, the latter UD-glass forms were preheated in an IR oven just prior to being placed in either the plaque tool or the engine shield tool. Heating time was dependent on the thickness of each material, but generally ranged from 30 to 140 sec for materials used in the plaque tool and 60 sec for materials used in the engine shield tool. The fabric/laminate materials were always placed in the tool first and then covered with the D-LFT charge.

Table I: Representative types of materials and layup combinations used to mold flat test plaques (n/a = not applicable for this sample)

Name of Combination	Materials	Nominal Wall (mm)	No. of Plies/Layers	Fiber Orientation of Each Ply (°)
V1	Pure Tape Fabric	2.0	4	(0/90)
V2	Pure Tape Laminate	2.0	1	(0/90) _{2s}
V3	Pure D-LFT	2.0	n/a	D-LFT
V4	Pure D-LFT	2.5	n/a	D-LFT
V5	Pure D-LFT	3.0	n/a	D-LFT
V6	Hybrid of Tape Fabric + D-LFT	0.5 + 2.5	1	(0/90) + D-LFT
V7	Hybrid of Tape Laminate + D-LFT	0.5 + 2.5	1	(0/90) + D-LFT
V8	Hybrid of Tape Fabric + D-LFT	1.0 + 2.0	2	2 x (0/90) + D-LFT
V9	Hybrid of Tape Laminate+ D-LFT	1.0 + 2.0	1	(0/90) _s + D-LFT
V10	Hybrid of Tape Fabric + Tape Laminate + D-LFT	2 x 0.5 + 2.0	1+1	(0/90) + (0/90) + D-LFT
V11	Hybrid of Tape Laminate + Tape Fabric + D-LFT	2 x 0.5 + 2.0	1+1	(0/90) + (0/90) + D-LFT

Because Oxeon's tape fabrics were produced in single layers, to create multilayer layups for the plaque molding, researchers needed a method to heat the plies to create a multiple-layer blank that could subsequently be placed in the tool. The method they used was that several sheets were placed next to each other in the IR oven, the PP matrix was heated close to its melting point of 200C, individual plies quickly but gently stacked on top of each other (without any additional pressure) to produce blanks of the required thickness, and then equally quickly they were moved to the nearby tool for molding. Since only single ply (0/90) fabrics were used in the shield molding, this extra stacking step was eliminated.



Figures 1a, b & c (left): Materials used in the shield molding trial were colored to see how they moved in the tool: tape fabric (top, in **black**), tailored blank (middle, **yellow**), and D-LFT charge (bottom, **blue**)

Figures 2a & b (right): How various materials looked in front (top – the side that faced the road) and back (bottom – the side that faced the underside of the vehicle) of molded shield part

MOLDING PARAMETERS

The smaller plaque tool was molded at $\approx 3,200$ kN pressure. During molding, dwell time in the plaque tool was about 45 sec at with a tool temperature of 75C. Because many of the parts molded in this tool were 3.0 mm thick, the 45 sec dwell time was selected to ensure the part reached the proper temperature prior to demolding. For thinner layups, a shorter dwell time could have been selected, but researchers wanted to keep molding conditions uniform so left thinner plaques in for 45 sec as well.

In the second part of the study, tool dwell time was actually shorter (at 30 sec) for the larger shield part because the tool was colder ($\approx 40-45$ C), allowing the part to freeze off more quickly so it could be demolded faster. Here, molding pressure was 12,000 kN. Section thickness was approx. 2.5-mm within the part. Since the compounding, oven heating, and molding cells were adjacent, it was possible to simultaneously heat fabrics or laminates and compound D-LFT while parts were being molded. In the case of the engine shield, that yielded an effective cycle time of ≈ 70 sec, which would be fast enough to keep pace with typical automotive production volumes even with this non-optimized manual sequence.

FLAT PLAQUE IMPACT TEST PARAMETERS

Once flat test plaques were molded and samples were removed, instrumented puncture tests were conducted. As previously noted, increasing impact strength of the base D-LFT material was a significant goal of the study and is the focus of this paper. A CEAST Fractovis testing machine equipped with a Type C clamping device (40-mm inner diameter) and a 20-mm hemispherical-shaped impactor was used to hit samples at a speed of 4.4 m/sec at room temperature (23C). In the pure material testing phase, samples were cut as 60-mm wide coupons. In the case of very-thin samples, which were either tape fabrics or tape laminates alone (without the additional pure D-LFT), the 60-mm coupons proved so thin that they pulled out of the clamping device during testing. Realizing there was a problem, researchers referred to a standard (*ISO 7765-2 for Film & Sheet; Determination of Impact Resistance by Free-Falling Dart Method – Part 2: Instrumented Puncture Test*) for testing foils (skin/foam laminates) and saw that an 80-mm sample was allowed in order to increase the clamped surface area of the specimen. For subsequent impact tests of the thinnest pure fabric or laminate, wider 80-mm coupons were cut and tested successfully for the pure fabric and pure laminate samples.

RESULTS & NEXT STEPS

PHASE 1 FLAT PLAQUE IMPACT TESTING – PURE MATERIAL COMBINATIONS

Impact testing of the pure D-LFT (at 2.0-, 2.5-, and 3.0-mm thickness), pure tape laminates (at 2.0-mm thickness), and pure tape fabrics (at 2.0-mm thickness) showed dramatic improvements in both impact energy at maximum force (**blue** bars) and total energy (**red** bars) for the UD-glass products (Figure 3). Results for both tape fabrics and tape laminates were similar and showed roughly a 9x higher values in total energy vs. those for straight D-LFT (control) materials without additional reinforcements – once again underscoring the benefits that longer reinforcement and higher FVFs have on stiffness/strength and toughness properties. It should be noted that this graph is useful for noting general (qualitative) trends but should not be used to obtain absolute (quantitative) values on samples of different thicknesses. This is because Young’s modulus varies with wall thickness (which is dependent on the ratio of D-LFT to UD-tape materials used in each plaque) and the second moment of inertia also is strongly dependent on wall thickness.

PHASE 1 FLAT PLAQUE IMPACT TESTING – HYBRID MATERIAL COMBINATIONS

The same tests were repeated for hybrid flat plaque samples as well. As previously noted, to better understand the influence of fiber orientation with these materials, coupons were cut so that each sample had a D-LFT side as well as a UD-tape side. Impact testing for the hybrid plaques was done on both the D-LFT and the UD tape and results were compared. This helped researchers better understand how real hybrid parts might respond in the end-use environment during a puncture-type impact event.

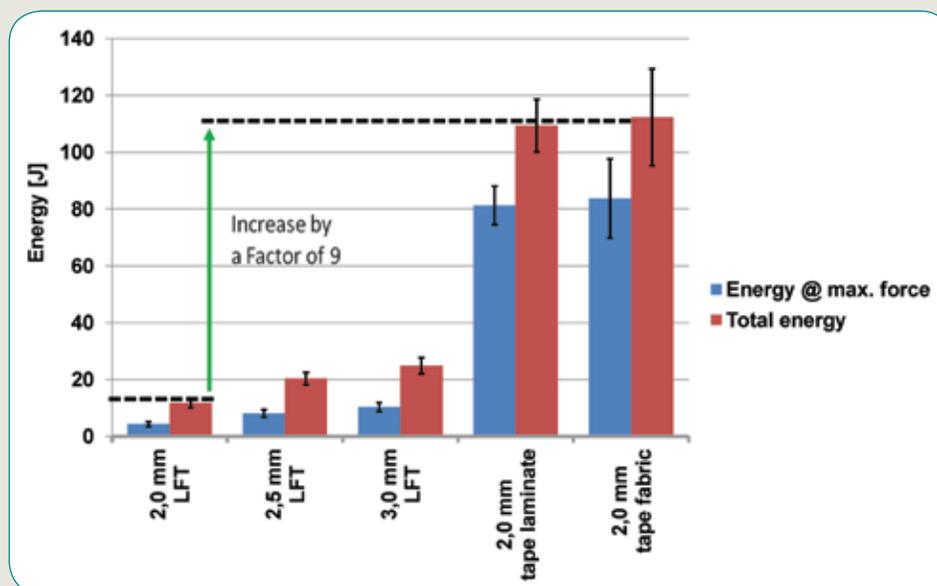


Figure 3 Impact energy of pure D-LFT (at 2.0-, 2.5-, & 3.0-mm thickness) vs. pure tape laminates and pure tape fabrics (both at 2.0-mm thickness) showing a 9-fold increase in performance with use of additional reinforcements

Figure 4 plots the pure D-LFT control materials against results from a number of the hybrid configurations (all at 3.0-mm thickness) from both the D-LFT and UD-tape (either tape fabric or tape laminate) side of the part. In all cases, the impacted side of a given sample was destroyed during the test. Not surprisingly, results were different for each side of a given hybrid pair of test samples. What’s interesting here is the values for impact energy at maximum force (blue bars) and total energy absorbed (red bars) for samples from a given part from both the D-LFT and UD-tape sides of the part. Energy at maximum force (blue bars) are always lower on the D-LFT side of a sample than on the UD-tape side for each pair – whether tape fabric, tape laminate, or a combination of both were used. The reverse trend is observed for total energy absorbed (red bars) for each pair of samples. Researchers believe that because the UD-tape side of each sample is stiffer and stronger, more energy is required to initially damage that side of the part (higher energy at maximum force) vs. the D-LFT side. On the other hand, because the D-LFT side of the part is not as stiff, it breaks more easily and sooner during impact testing, absorbing less initial energy (lower energy at maximum force) during testing while simultaneously putting the UD fibers on the reverse side into tension (higher total energy), so when they are finally impacted (as the D-LFT side fails), less kinetic energy is left in the impactor.

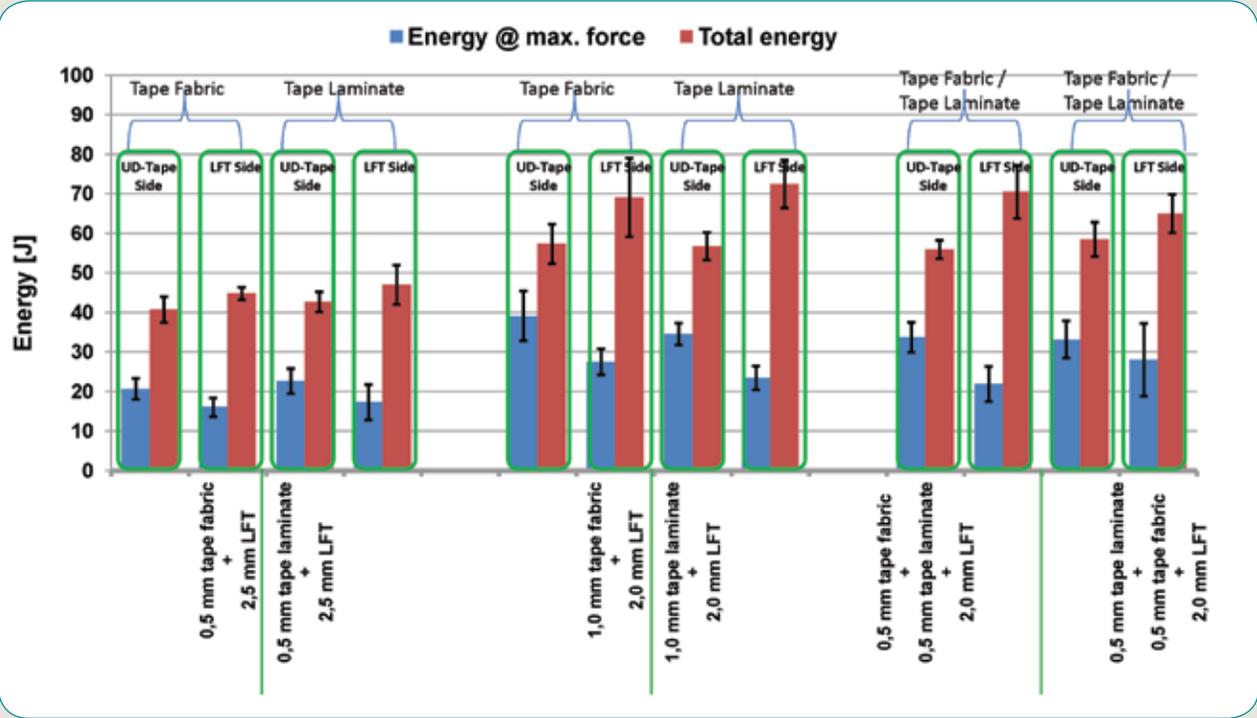


Figure 4: Summary of impact performance for both impacted sides of the hybrid configurations with respect to UD-tape (tape fabrics, tape laminates, or both) and D-LFT sides of part

PHASE 2 ENGINE-SHIELD MOLDING DEMONSTRATION

Since the goal of the engine-shield molding trial was to evaluate whether the UD-tape products could successfully be used in the tailored D-LFT process in a cycle time that would be realistic for a commercial automotive part production, no further testing of these molded parts took place. While the effective cycle time for the shield parts was 70 sec with a non-optimized manual transfer of preheated UD-tape products, it is still well within the range of acceptable cycle times for thermoplastic composites and is vastly faster than similar performing thermoset composite offsets. The actual tool dwell time was just 30 sec, which is good even by thermoplastic composites standards. Since the limiting process step was preheating the UD-tape products, researchers are confident that with a staged oven, an automated materials handling setup, and a tool equipped with clamps/fixtures to hold UD-tape products, that total cycle times could be driven lower.

SUMMARY AND NEXT STEPS

Both phases of the study reiterated results seen in numerous other studies that longer fibers and more fibers increase stiffness/strength and impact resistance (toughness) of parts. The study also showed the benefits of a hybrid molding process like tailored D-LFT. Although pure tape fabrics and pure tape laminates provide better ultimate performance at a given wall thickness, these materials are more costly to use per unit weight than pure D-LFT and can pose filling challenges for parts with complex geometry such as thin ribs if used alone. They are best suited for selectively adding performance locally where needed.

Similarly, while the discontinuous glass (in significantly lower FVFs) in the pure D-LFT lacks the stiffness/strength and impact performance of the UD-glass products, but it offers better flow properties to fill a complex part geometry like was present in the engine-shield tool. By using a hybrid approach like tailored D-LFT, the best features of one material compensates for the weaknesses of the other material and vice versa with a result that should improve durability and length of service life for thermoplastic composite parts. This, in turn, can be used to either improve performance of a given compression molded D-LFT part at comparable wall thickness and only a modest weight increase vs. a pure D-LFT part, or it can be used to provide comparable performance with less material at thinner walls.

ACKNOWLEDGEMENTS

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SOCIAL REPORT

Teri Chouinard



Social Events Help Us “Enjoy The Ride” and Drive Membership

Close to 40 automotive engineering professionals enjoyed an SPE holiday party on Dec. 17th that included a tour of the Chrysler Museum. The venue featured 23 classic Chrysler vehicles on display with holiday trees and fashions representing the eras of the display vehicles. The exhibits were interesting, educational, and beautiful, contributing an elegant ambiance to the occasion. After the tour, everyone gathered in the museum’s Viper Café for drinks, appetizers, networking, and fun.

The purpose of the event, besides celebrating the end of 2012, was to encourage new membership. SPE Automotive Division and Detroit Section members were invited and each could bring a guest.

The event was planned quickly upon learning that the Chrysler Museum was scheduled to close to the public at the end of the year. Knowing that this might be the last chance to see this great collection of cars helped drive attendance.

Social events will be planned throughout the year, approximately once 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 easier for those working in or visiting Southeast Michigan.



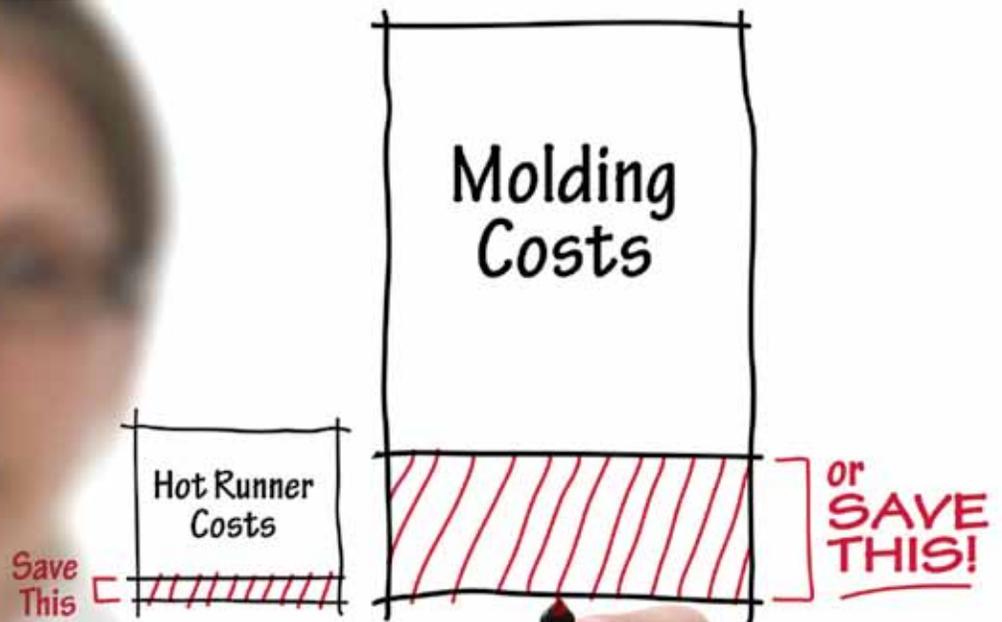
The next Social Event is planned for March 21, 2013. It will include a tour of the Ford Rouge Plant – SPE Automotive Division members are invited and encouraged to bring a potential member as a guest. **MUST RSVP.** Details will be sent shortly by eBlast. We’ll meet at The Henry Ford IMAX Lobby (20900 Oakwood Blvd., Dearborn, MI 48124) at 2:30 pm and take a bus to the Rouge Plant at 3 pm, which is the last bus of the day. Be on time – if you’re late you will miss out.

The tour will last about 1½ hours and we’ll be bussed back to The Henry Ford to continue networking at nearby Bailey’s Pub N’Grille (22091 Michigan Ave., Dearborn, MI phone: 313.277.3212). Additional parking is available on the street behind Bailey’s. SPE Automotive will sponsor the tour and appetizers and non-alcoholic beverages at Bailey’s. If you can’t make the tour, join us at Bailey’s after work. Watch your email for an invitation with more details.

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 810.797.7242.

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SECRETARY'S REPORT

SPE Automotive Division Board Meeting Minutes December 10, 2012



ATTENDEES (italics)

Yvonne Bankowski
Bonnie Bennyhoff
Jeff Bonello
Sheldon Brown
Teri Chouinard
Fred Deans
Neil Fuenmayor
Anthony Gasbarro

Ed Garnham
Brian Grosser
Jeff Helms
Vincent Holmes
Chuck Jarrett
Elizabeth Johnston
Norm Kakarala
Mark Lapain

Peggy Malnati
Mike Masserant
Al Murray
Kevin Pageau
Tom Pickett
Bill Pippine
Monica Prokopyshen
Jay Raison

Nippani Rao
David Reed
Jackie Rehkopf
Suresh Shah
Mike Whitens
Ron Price
Suzanne Cole
Ed Luibrand
Dawn Stephens

Meeting was held at ACC in Troy, 5:30 p.m. – 8:05 p.m.
October minutes were approved.

COUNCILOR REPORT – Tom Pickett

Tom Pickett provided highlights of the SPE virtual council meeting of 54 attendees that was held Dec. 5, 2012. The Sept. 15 councilor meeting minutes were approved. Expenses are \$200K below budget with a projection of \$100K negative to the 2012 budget, and a prediction that ANTEC Mubai will make money. The main sources of revenue are: membership, ANTEC conferences, and Topcons. Costs include publications, councilor meetings, ANTEC advances (large upfront costs to secure facilities), group rebates, business expenses (foreign offices, staffing, and new software for membership and event registration). Expenses for 2013 are projected to be higher than in 2012. Council approved most changes to bylaws and policies, but opposed the rebate change from dollar amount to percentage based. Group formation requirements were presented. Need to comply with US laws in dealing with other countries. For example, a 501(c)(3) is US tax exempt category and may not be recognized outside the US.

MEMBERSHIP – Mike Masserant

Membership is higher than at this time last year. The on-line renewals process is not working well. SPE HQ requested assistance training 100 engineers at Ford (China). A Thermoplastics vs. Thermosets video training session is available and was conducted together with the Automotive Composites Alliance (ACA) during ACCE 2012. There also is work underway to make the Ticona Plastics 101 course generic to facilitate training membership.

SOCIAL MEETING – Teri Chouinard

Teri proposed conducting networking events at facilities near each manufacturer's location (Chrysler, Ford, GM, Toyota, etc.) The first location proposed was the Chrysler Museum, since the venue is closing to the public at year end. The BOD approved the proposed date of Wednesday, December 19th, 6:00 pm – 9:00, with a maximum outlay of \$1300. The event will include a 1-hour guided tour of the museum, showcasing 23 Christmas Trees, 23 Cars and fashions of each era, followed by a 3 hour networking event at the museum's Viper Café. Hors d'oeuvres

will be served, and board members are each requested to bring a new member. The focus is to familiarize Chrysler people with SPE and to attract new members.

EDUCATION – Monica Prokopyshen

For student participants of the 2012 ACCE, the board approved monies (\$1736) to split 4-year student membership costs with the Composites Division.

TREASURER'S REPORT – Jackie Rehkopf

The major IAG bills have been paid: Concept Pro TV, Florist, and Burton Manor. Payments for 30 Early-Bird sponsors for ACCE 2013 are due Dec. of this year. Two past due ACCE 2012 sponsor payments and IAG outstanding accounts receivable (~\$12 K) still need to be collected. Follow-up plans were discussed. Today's Treasurer's summary did not include receipts of approximately \$30 K processed through PayPal. The account status as at Dec. 10, 2012 was: checking (\$87,785.63) plus savings (\$27,403.62) for a total of \$115,189.25.

ANTEC – Anthony Gasbarro

Anthony Gasbarro reported that ANTEC 2012 had 1,432 attendees and that Tom Pickett and Suresh Shah have volunteered as 2013 ANTEC reviewers for the SPE AD track.

MARCOM – Peggy Malnati

2012 ACCE Summary – The final registration was 636, with 53 sponsors and an estimated net income of \$28,243.34 to the SPE AD. The new theme, banner, car art, program guide cover design and conference dates have been finalized: Composites Lightweighting the Cars of Tomorrow (Sept. 11-13, 2013). The conference co-chairs are Antony Dodworth and Creig Bowland. As of Dec. 10th, 35 early-bird sponsorships have been sold. The call for papers flier is being shipped to teams for distribution at conferences in Europe, Asia and North America.

IAG – (Nov. 7, 2012) At 72 pages, this year's program guide was the largest to date. The night of the event, the winners release was distributed, the IAG web page was updated and the award's night module was launched. Six press releases were issued throughout 2012, with good pickup.



Secretary's Report

CONTINUED FROM PAGE 33

SPE AD Website – The new banner and updates have been launched. As usual, traffic petered off in November. The website continues to set new records for unique monthly traffic with an all-time high of 36,035 (Aug) and levels above 34,000 unique hits for Sept., Oct. and November.

SPE AD Newsletter – The December issue (Innovation Awards focus) will be posted on the website this week and over 1400 copies of the December issue (32 pages) are being mailed. A new guest feature launches this issue, "An Engineer's Life," authored by Anthony Gasbarro (Marubeni Specialty Chemicals), writing about his experience as a plastics engineer. Also, the Batter's Box op-ed column introduced in Sept. continues with a piece by Matthew Naitove, Executive Editor, Plastics Technology magazine, writing about what it was like to be an Innovation Awards Competition judge.

Duplicate retractable banners (SPE HQ and SPE AD) were produced due to SPE AD's presence at 3 concurrent events in early Nov. The banners have been well received by the audiences.

SPONSORSHIP – Teri Chouinard

Teri reported \$36,200 in newsletter sponsors.

NEW BUSINESS/OTHER – Jeff Helms

- Regarding the SPE Connect initiative, SPE HQ still wants to launch, and requests \$5,000 in seed money from major divisions and sections. SPE Connect will serve as a social media hub for divisions and sections.
- Peggy is completing the year end submission for the Communications award.
- Yvonne is spearheading the Pinnacle award submission.
- Polymotive magazine is being folded into the combined print/electronic "Plastics the Global Application Medium," which will be printed and electronic – online and in tablet format.

Next BOD Meeting: February 11, 2013

EDUCATIONAL OUTREACH

A major focus of the SPE Automotive Division (SPE AD) is educational outreach at all levels from grade school, through and post college. We partner with other sections and divisions (Composites, Detroit, and National), colleges, industry, and organizations to reach more volunteers and a wider audience.

The Division sponsors the ANTEC (*SPE's Annual Technical Conference*) Student Activity Fund. We also fund college scholarships and sponsor and participate in additional educational outreach programs through the PlastiVan® Program (middle school), Formula SAE®, the ACCE graduate scholarships and student poster competition for undergraduate and graduate students, Transportation Design Projects (College for Creative Studies) and Explorathon®.

For 14 years the SPE AD has funded and presented annual environmental design / plastics workshops at Explorathon®, a STEM (*Science, Technology, Engineering and Mathematics*) career fair for middle and high school students of Southeastern Michigan.

MEMBER EDUCATION AND NETWORKING

SPE AD offers an ongoing program of high-quality conferences, papers, and networking events. The Division presents technical sessions at ANTEC, and co-hosts topical conferences (such as the Automotive Composites Conference & Exhibition (ACCE) and the Automotive Engineering Plastics Conference (AutoEP-CON)), and co-operatively promotes works with and by other organizations and engineering societies to increase knowledge about current and future automotive plastic applications.

INNOVATION CATALYST & INFORMATION SHARING

A highlight of the year is the annual SPE Automotive Innovation Awards Competition & Gala (IAG), which showcases the year's most innovative uses of plastics in automotive applications and recognizes leaders in the field. The IAG student usher program introduces the next generation of plastics professionals to the current inventors and practitioners. Since the 1990s, photographs and summaries of these technological breakthroughs have been posted on our website. Recently, we have partnered with the American Chemistry Council to further enhance the delivery and distribution of this information.

To enhance services to our widespread membership, the division shares best practices and disseminates news and technical information electronically in E-blasts, LinkedIn, Tweets, conference proceedings, newsletters and through our website and blog: <http://www.speautomotive.com/> and blog <http://speautomotive.wordpress.com/>.

A large selection of technical papers and presentations are available from past SPE ACCE shows is available on our website and award-winning papers are reprinted in this newsletter.



Visit the main Society of Plastics Engineers' website for up-to-date information on training, seminars, and other career enhancing information.

www.4spe.org



SECRETARY'S REPORT

SPE Automotive Division Board Meeting Minutes February 11, 2013



ATTENDEES (italics)

Yvonne Bankowski
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Mike Masserant

Al Murray
Kevin Pageau
Tom Pickett
Bill Pippine
Monica Prokopysheh
Jay Raison
Nippani Rao
David Reed
Jackie Rehkopf

Suresh Shah
Mike Whitens
Ron Price
Suzanne Cole
Ed Luibrand
Dawn Stephens
Mark Nobels (Samsung)

Meeting was held at ACC in Troy, 5:30 p.m. – 7:16 p.m.
December minutes were approved.

COUNCILOR REPORT – Tom Pickett

No report – no council meetings have occurred since the last BOD meeting.

MEMBERSHIP – Mike Masserant

Ford employees and Jeff Helms will train 100 engineers at Ford (China) using the SPE AD's Plastics 101 course, which has 30 modules. The program will be tailored and tested in China, then evaluated for expansion to other regions.

SOCIAL MEETING – Teri Chouinard

Close to 40 automotive engineering professionals enjoyed an SPE networking event that included a tour of the Chrysler Museum on Dec. 17. The tour featured 23 classic Chrysler vehicles displayed together with holiday trees and fashions of the respective eras. Networking event locations are rotated around Metro Detroit on a quarterly basis. The spring get together includes a tour of the Ford Rouge plant on March 21, 2013.

EDUCATION – Monica Prokopysheh

The SPE AD is supporting the 2013 Explorathon (STEM career fair for grades 8-12) with 3 Designing with Plastics workshops. The date is March 20, 2013 at Cranbrook Kingswood Middle School (new location for 2013). As usual, the day long event is open to students (including home-schooled) from south-east Michigan. The American Association of University Women (AAUW) has coordinated this large event for over 30 years. One of our handouts this year will be the Engineer's Life articles from SPE AD's newsletter. A sum of \$2,000 was approved for the ANTEC Student Activity fund.

TREASURER'S REPORT – Jackie Rehkopf

The cash flow is good. A request for tax extension was submitted. \$45K was received from Ticona since the previous report.

ANTEC – Suresh Shah

Six papers have been received. Suresh Shah and Tom Pickett are paper reviewers and session moderators.

MARCOM – Peggy Malnati

2013 AutoEPCON – The banner, icon and details for the April 30, 2013 annual conference are posted on the website. Call for Presentation fliers are printed and available at the Troy SPE (ACC) office.

2013 ACCE – The Call for Papers fliers have been printed and copies are available at the ACC. Ads are being placed. Forty-one sponsors took advantage of the early-bird discount and 99% of

the sponsor fees have been paid, covering fixed costs for the conference. Three papers have been received to date and the 1st press release is in the approval process. A few new members have joined the experienced committee, broadening outreach.

IAG – Trophy and award orders are still being received and articles on nominations and winners are running in many publications. Jeff Helms provided a summary of the February 9th IAG planning meeting. A date of Wed., Nov. 6, 2013 for the gala has been confirmed with Burton Manor and a working theme of Plastics: Kick the Metal Habit is being used. Two ad designs in 2 different color schemes were provided to the BOD for a vote and a clear winner was selected. Improvements planned for 2013 include online plaque ordering and the possible addition of an electrical / electronics systems category. Nominations are being accepted for the Lifetime Achievement award. The BOD and BRJ judge selection and balloting processes are being updated and criteria will be published.

SPE AD Website – A year-by-year analysis of web traffic was provided, which showed seasonal traffic trends and year over year improvements. We've consistently been in the 34,000-35,000 unique hits/month range for the last half year.

SPE AD Newsletter – The well received, "An Engineer's Life" column will return in the next newsletter with a notable guest author. The third issue of the "Batter's Box" column will be by-lined by Lindsay Brooke (*Automotive Engineering International* magazine and SAE International®).

SPONSORSHIP – Teri Chouinard

A proposal to provide conference and newsletter sponsors with a "new membership" as part of their fee was assigned to the Membership committee for follow-up.

NEW BUSINESS/OTHER

The \$5,000 seed money for SPE Connect was approved and sent to SPE HQ.

Peggy submitted a nomination for the Communications award and Yvonne submitted the Pinnacle award application.

A new sign was installed at the ACC door to show that SPE also resides there.

The ConstantContact online registration (and e-blast) application has been shared by the SPE AD and Detroit Section, but the capacity of a maximum of 10 events is no longer sufficient. Consequently the SPE AD and the Detroit Section will each have separate registrations under the service.



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