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

May 2010 - Volume 39, Issue 4

SPE AutoEPCON Highlights Innovative Technologies to Add Value, Reduce Cost in Automotive Applications

The ***SPE® Automotive Engineering Plastics Conference (AutoEPCON),*** organized by the Detroit Section and Automotive Division of the Society of Plastics Engineers (SPE®) International, returned for its fifth year on April 27, 2010 for a full day of technical presentations, keynote addresses, exhibits, and a networking reception sponsored by SPE at day's end. Despite several years of severe cutbacks in both the automotive and plastics industries, this year's show was well attended and full of presentations on new technologies to help automakers add value and reduce cost and weight of components with engineering plastics.

The conference featured four keynote speakers who helped frame both the challenges and opportunities facing the supply community as well as automakers as this industry struggles to emerge from the record downturns of the past few years. Right after opening remarks by 2010 ***SPE AutoEPCON*** event chair, Nippani Rao, Dale Gerard, Ph.D., senior manager-North American Materials, General Motors Corp., spoke on "*New Developments at the New GM: Plastics & More*." He was followed by Volker Warzelhan, Ph.D., senior vice-president, Polymer Research-Thermoplastics at BASF SE, who gave a talk entitled "*Innovation Pipeline – Engineering Plastics*."

Before lunch, Vivek Jain, Ph.D., global R&D director, Ticona Engineering Polymers, presented a talk entitled "*Driving Innovations in the Automotive Industry*." Following lunch (which was sponsored by Ticona), Koen Devits, business unit director, DSM Engineering Plastics -Americas discussed "*Innovative Sustainable Solutions Utilizing Engineering Plastics*."

The 16-presentation technical program featured two parallel technical tracks morning and afternoon and a surprising number of the talks highlighted new materials and process technologies. Speakers from DuPont Automotive described a new nylon said to double the service life of powertrain components and in a second talk discussed uses of laser welding for creative and cost-effective solutions. A speaker from Flynn Burner Corp. explained why flame plasma surface treatments (to increase adhesion to polymer surfaces) are both

Continued Page 4

Treasurer's Report

Yvonne Bankowski

The SPE Automotive Division bank account balance is in good standing with $132.6K in checking and $27.4K in savings for a total of $160K. SPE Automotive donated $500 to support the student activities at the 2010 ANTEC Conference in May, $3,750 to the National Plastics Center and Museum to support the PlastiVan Education Program and an additional $1,000 to PlastiVan who is sponsoring 50 students at ANTEC.

Education Report

Monica Prokopyshen

Student Support for ANTEC Activities
Since the last education report, the SPE AD voted and approved financial support for the following student activities at ANTEC: a $500 contribution for the college Student Activities Committee and $1,000 to support the transportation (busses) and lunches for 50 high school students to spend a day at ANTEC. The high school student program is being coordinated by Marjorie Weiner of the Plastivan Education Program. These two initiatives augment the long-standing SPE Automotive Division financial contribution for the ANTEC student travel fund.

Automotive Division Meeting Schedule and Special-Events Calendar

SPE Automotive Division/ Automotive Composites Alliance Golf Outing Fieldstone Golf Club, 1984 Taylor Road, Auburn Hills, Michigan	September 14, 2010
10th-Annual SPE Automotive Composites Conference & Exposition MSU Management Education Center, Troy, MI	September 15 & 16, 2010
Automotive TPO Global Conference Best Western Sterling Inn	October 3-6, 2010
40th-Annual SPE Automotive Innovation Awards Program & Gala Burton Manor, Livonia, MI	November 9, 2010

Automotive Division Board of Directors meetings are open to all SPE members, and are usually held at the American Chemistry Council (ACC) in Troy, MI.
Call Jeff Helms at (248) 337-6895 for more information.

www.speautomotive.com

Social Chair Report

Bill Pippine

SPE Automotive Division last year created the Social Chair position to aid in the growth and awareness of SPE in the changing automotive industry. As part of this initiative, we have held several informal social gatherings around the metro Detroit area. These events are intended to be informal and allow an opportunity for new members or past members to socialize with board members of the SPE Automotive Division. The events have been growing and we will be planning additional events for this fall. Stay updated by visiting www.speautomotive.com and look for emails about future events. If you have an idea for a future event, please contact the Social Chair at social-chair@speautomotive.com .

Chair's Message

Jeff Helms

The new fiscal year for the Society of Plastics Engineers Automotive Division has begun and I am honored to serve as the Division Chair for 2010-2011. I also look forward to a year of cautious optimism within the automotive industry after the Great Recession of 2009. Many companies, doing financially better today, have begun to embrace innovation in plastics more aggressively than in the past in order to meet current and forthcoming product needs and requirements. I think we see this increased cautious optimism and innovation in our Divisional activities already.

The AutoEPCON Conference was held April 27th at the MSU Management Education Center in Troy and by numerous accounts, was highly successful. The theme of innovation was addressed by four keynote speakers including Dr. Dale Gerard from General Motors, Dr. Volker Warzelhan of BASF, Dr. Vivek Jain of Ticona Engineering Polymers and Koen DeVits of DSM Engineering Plastics. Thanks to Nippani Rao and the SPE Automotive Volunteers for pulling together such an exciting program.

The Division also hosted a technical session at ANTEC on May 17th in Orlando. Thanks to Tom Pickett for taking the lead on our participation at the ANTEC technical meeting. Also at ANTEC, the Automotive Division received two awards. The Pinnacle Award Program was established in 2005 to recognize Sections and Divisions that successfully create and deliver member value during year. Sections and Divisions are reviewed in four categories of achievement: organization, technical programming, membership and communication. The Automotive Division has achieved the Gold level award for 2010.

In addition, thanks largely to Peggy Malnati's service to the Division, the Automotive Division received the 2010 Communications Leader Award, the highest level available under the Communications Excellence Award program launched in 2009. Way to go Peggy!

We are already in the planning stages for three more technical conferences this year including the 12th Annual SPE Automotive TPO Global Conference on October 3-, the 10th Annual Automotive Composites Conference and Exhibition on September 15-16 and our 40th Annual SPE Automotive Division Innovation Awards Gala on November 9. Complete information for these three events is available on -line at www.speautomotive.com. In addition, we have also begun the planning for the SPE Automotive Annual Golf Outing on September 14th at Fieldstone Golf Club. Please join us at a great event for meeting colleagues or entertaining customers.

Our Board of Directors will meet in early June to define the Division strategy and priorities for the upcoming year as well as filling key leadership positions. Many of our volunteer leaders will be continuing in new roles or extending their current ones, but we are always interested in new faces and ideas that will move the Division forward and meet the interests of our membership. If you are interested in participating actively in the Division leadership, please contact me of one of the other Board members and join us at the Board of Directors' meeting. This meeting is held every other month at the American Chemistry Council office in Troy. We will be soliciting names for our new Vice Chair, Membership Chair and open Director's positions.

The primary role for the Division is to promote the use and benefits of plastics in the automotive industry, to educate generations of automotive plastics engineers and to serve our members' continually changing needs. We have continued our sponsorship for student scholarships, educational programs and our technical programs even through the economic turmoil of 2009. We are positioned now, with your help, to be more aggressive in our outreach and relevant to our membership. Innovation in plastics engineering has never been more important than it is at this time.

AUTOEPCON HIGHLIGHTS

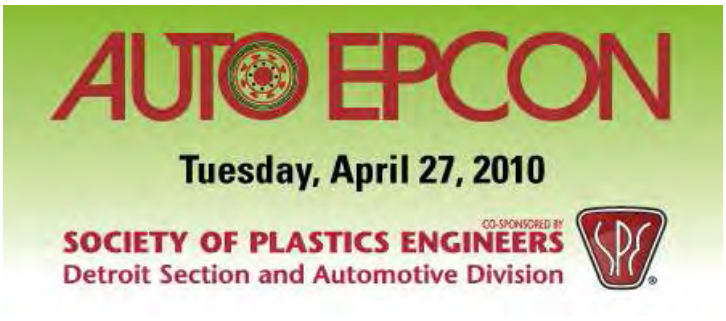
Continued from Page 1

commercially viability and a green alternative to conventional treatments like primers. A speaker from Chevron Phillips introduced new polyphenylene sulfide (PPS) compounds specifically formulated for battery coolant-system applications, while a talk by Bayer MaterialScience described an innovative new direct coating/skinning process to produce high-quality decorative surfaces in a single shot, and a BASF presenter discussed the use of silicone adhesives as a sealant for thermoplastic engine components.

Presentations from Ticona Engineering Polymers covered innovative PPS blow-molded air ducts for turbocharged diesel engines, new liquid crystal polymers (LCPs) to facilitate further miniaturization of automotive electronics; copolymer polyoxymethylene (POM, acetate) for high-strength, high-impact applications; long-fiber thermoplastics for weight and cost reduction on vehicle interiors; reduction of volatile-organic compounds (VOCs) on vehicle interiors for sustainability and passenger comfort; and new materials developed to meet the challenges of hybrid/electric vehicles.

DSM Engineering Plastics had two speakers: the first on the use of high-performance engineering plastics for challenging auto applications; and the second on a new tube concept to boost chemical and mechanical performance. Additionally, a speaker from Matereality LLC explained how new materials databases enabled modeling for diverse computer-aided engineering (CAE) applications.

"Given the tremendous difficulties our industry has experienced in the last two years," said Norm Kakarala, Ph.D., senior technical fellow, Inteva Products LLC, "it's really remarkable that we're seeing this level of innovation so early in the recovery process. Clearly, the supply community has responded to automakers' need to take cost and weight out by developing more efficient materials and processes that add value to components." Kakarala, a former SPE Automotive Division chair, founded the



AutoEPCON show and served as its 2010 technical program chair.

Speaking about the 2010 show, Nippani Rao, who retired from Chrysler LLC last year and is now president of Rao & Assoc. as well as this year's ***AutoEPCON*** event chair, said "At a time of great change in the automotive industry, ***SPE's AutoEPCON*** remains an excellent resource for keeping up-to-date on breaking innovations in engineering plastics. These high-performance materials keep making new inroads in thermally and chemically aggressive environments under the hood, in semi-structural applications in chassis/powertrain, and by meeting increasingly demanding aesthetic and

cost challenges on vehicle interiors. Our 2010 program provided an excellent overview to the latest developments in these versatile materials for anyone working in design, engineering, manufacturing, or purchasing for ground transportation."

The 2010 ***AutoEPCON*** show was held April 27 at the MSU Management Education Center (**www.mectroy.co**) in Troy, Mich. , and focused on *Design, Materials, Processing, & Use of Engineering Plastics for the Global Automotive Industry*. Support for the 2010 event came from *Premier* sponsors, Ticona Engineering Polymers and DSM Engineering Plastics; *Associate* sponsors, AsahiKasei Plastics North America, BASF, JSP, Chevron Phillips Chemical Co., DuPont Automotive, Adell Plastics Inc.; *Break/ Lunch/Advertising* sponsors, Entec Polymers LLC, Bayer MaterialScience, DatapointLabs, ANSYS, Detroit Testing Labs, and DME; as well as *Media/Association* sponsors, *Automotive Newswire* magazine, *Automotive Engineering International* magazine, *Ward's AutoWorld* magazine, *Plastics Technology* magazine, *Automotive Design & Production* magazine, and *Plastics Engineering* magazine.

The Detroit Section and the Automotive Division of the Society of Plastics Engineers (SPE) International developed this one-day technical conference and exhibition to specifically focus on engineering plastics for the automotive industry. First held in 2006, ***AutoEPCON*** features technical presentations on the newest advances in materials technology, predictive engineering, process enhancements, and application developments for thermoplastic and thermoset engineering plastics for the automotive industry. Exhibits are also on display throughout the event. The registration fee includes the Conference Program Book, which contains abstracts of the presentations, as well as lunch, refreshments, and a reception, which provides further networking opportunities for all who attend. In addition, this one-day multi-session conference includes four keynote addresses from industry leaders.

The Washington Update

By Suzanne Cole, Past Chair SPE Automotive Division and Environmental Divisions

Washington is buzzing with Congressional activity on issues ranging from financial reform to climate change and automotive safety. New legislation has been proposed to promulgate new regulations, increase statutory authority, increase fines, and increase oversight on several agencies including the National Highway Traffic Safety Administration (NHTSA) and the Department of Transportation (DOT).

THE MOTOR VEHICLE SAFETY ACT OF 2010

The House Energy and Commerce Committee drafted sweeping legislation that reshapes auto safety regulations and significantly increases potential fines against automakers for violating safety laws. The legislation, drafted by Rep. Henry Waxman (D-CA) and Rep. Bobby Rush (D-IL), would create at least half a dozen new safety standards and rules — including a requirement that all new motor vehicles have event data recorders and brake override systems.

The legislation, titled "The Motor Vehicle Safety Act of 2010", would represent one of the biggest overhauls of federal motor vehicle safety regulation in a generation. The most recent comparable action came a decade ago, when Congress passed the TREAD act resulting from the rollover problem involving Ford Explorers equipped with Firestone tires.

Increased Fines

The bill is likely to face opposition, in particular over a provision that would remove the existing $16.4-million cap on civil penalties against vehicle manufacturers for violations of safety laws and boost the fine for each violation to $25,000, from the current $6,000. The change would create the potential for fines in the range of tens of billions of dollars, because federal fines are typically assessed on each vehicle produced by a manufacturer that is involved in a violation of the rules.

NHTSA's recent record $16.4-million fine against Toyota for violations of U.S. law could have been as high as $57.5 billion if the proposed Waxman law had been in effect at the time.

The proposed law will be considered in a hearing on May 6 by the House Energy and Commerce subcommittee on commerce, trade and consumer protection.

Immediate Recalls

The Motor Vehicle Safety Act of 2010 provides NHTSA the authority to order immediate recalls if it finds an "imminent hazard of death or serious injury" and provides the affected company the ability to seek expedited judicial review of the recall order.

New Vehicle Tax

The measure has several other provisions including creating a new tax which begins at $3 per new vehicle and increases to $9 after three years, payable by the manufacturer, to help fund NHTSA and some of the new requirements of the law. The tax could raise more than $100 million a year based on current sales figures.

Corporate Responsibility for Accuracy of Information

The proposed bill requires that auto manufacturers have a senior executive in the United States certify the accuracy and completeness of all responses to NHTSA's request for information relating to safety investigations. It also establishes civil penalties for auto executives who knowingly provide false, misleading or incomplete information to federal regulators and would hold them liable for fines of up to $250 million.

Vehicle Electronics

Beyond fines and taxes, the bill would dramatically overhaul DOT/NHTSA's ability to oversee rapidly advancing electronics technology and would establish a new Center for Vehicle Electronics and Emerging Technologies within NHTSA to strengthen NHTSA's expertise in new technologies across all vehicle safety components. It also creates an honors recruitment program at NHTSA for engineers with an interest in vehicle safety.

NHTSA currently employs 125 engineers of which only 2 are electrical engineers.

The measure would require automakers to adopt brake overrides, which cut engine power back to idle when the brake pedal is depressed. It would also set separate new standards on the placement of foot pedals, keyless ignition systems and transmission shift controls.

In addition to requiring event data recorders, the bill ensures public access to currently confidential early warning data reported by automakers and creates a new hotline for mechanics and others to confidentially report safety defects.

Senate Bill

A Companion Bill was introduced yesterday in the Senate which is also titled the Motor Vehicle Safety Act of 2010. It calls for a doubling of NHTSA's budget beginning next year. Most likely a portion of the expanded budget will be earmarked for hiring electrical engineers in the Office of Defects Investigation and the new proposed Center for Vehicle Electronics and Emerging Technologies.

We expect significant lobbying will take place to further shape both the House and Senate Bills. Miller Cole has been asked to participate in the House and Senate hearings beginning this week. For up to the minute information please contact Suzanne Cole at (202) 621.1899.

Senator Boxer (D-CA) Introduces Bill to Limit Hiring of Former Regulators

Also resulting from the Toyota recall hearings, held in the U.S. House and Senate in February and March, Senator Barbara Boxer (D-CA) introduced legislation that would close the "revolving door" between the National Highway Traffic Safety Administration and automotive manufacturers.

The legislation would bar former NHTSA employees from working for auto manufacturers in any capacity that required written or oral communication with the agency for three years.

The revolving door issue has come to light during recent inquiries into the safety of Toyota vehicles. As the Washington Post recently reported, "Dozens of former federal officials are playing leading roles in helping carmakers handle federal investigations of auto defects, including those for Toyota's runaway-acceleration problems." Concerns have been raised that former NHTSA employees are using their influence to benefit automotive manufacturers and impeding the enforcement of safety standards and regulations.

Senator Boxer's bill would apply to high-ranking NHTSA officials, as well as individuals whose responsibilities during their last year at the agency included any motor vehicle safety-related program.

Individuals who violate the revolving door prohibition would be subject to current penalties under government-wide ethics laws. Those penalties stand at $55,000 for an individual. Manufacturers would also be subject to civil penalties including a fine of $100,000 or more.

The legislation follows the recalls of more than nine million Toyota vehicles worldwide since the fall of 2009, including two major recalls for problems with sticking accelerator pedals.

Miller-Cole LLC is a Washington, D.C. based firm dedicated to serving the Automotive, Chemicals, and Plastics industries with up to date analysis, appropriations including research and development funding, legislative and regulatory issues management and lobbying. We simplify the global government maze for corporate competitive advantage.

Miller-Cole's recent "Total Recall Study" outlines world-wide vehicle recalls, regulations, trends and analysis of proposed vehicle regulations.

For more information contact Suzanne Cole at suzannecole@miller-cole.com, (202) 621-1899

SPE Automotive Division Board Meeting Minutes

April 12, 2010

ATTENDEES

Yvonne Bankowski, Terri Chouinard, Fred Deans, Anthony Gasbarro, Jeff Helms, Norm Kakarala, Peggy Malnati, Mike Masserant, Kevin Pageau, Tom Pickett, Bill Pippine, Monica Prokopyshen, Nippani Rao, David Reed, Jackie Rehkopf, Ben Soltisz, Suresh Shah, Mike Whitens

Meeting held at ACC in Troy, 5:30 p.m. – 8:00 p.m., Feb. minutes approved

Education

Comments from the students and teaching aids at this year's Exploration sessions were again excellent and the students gave high marks for the session content, materials and presentation style. Sample comments were read at the board meeting: "I have never seen a workshop that held the girls' interest to such a degree. I'm sure many will be inspired to take chemistry because of you." We were able to include additional experiments and discussions, since the sessions were 10 minutes longer. The Plastivan is in Taylor this week.

Membership

Johanne Wilson sent out the membership initiative request Jan 21. 15 names were proposed. Each board member has been asked to recommend 2 names by the end of the month. Membership was down in 2009.

SPE Social Programs

Bill Pippine reported that the April networking meeting will be in Warren. There was good turnout at the last event, with increased numbers of participants.

Treasurer's Report

Read the treasurer's report for full details. The account balance is as follows: checking $142.6 K, savings $27.4K and total $170K. The funds include advance payments for upcoming conferences and sales of IAG mementos and awards.

Technical Committee

Tom Pickett reported on the division's ANTEC preparations for the session being held Monday May 16th (pm). Jay Raisoni is moderator for the session for which there are 2 keynote speakers and 5 papers. The business meeting is scheduled for 5:00 – 5:30, immediately following the automotive session.

Councilor's Report

No councilor meetings since the last report.

Inter-society

Jackie Rehkopf reported on discussions being held with the American Society of Civil Engineers (ASCE) to organize symposia at each others' conferences as well as discounted joint memberships.

AutoEPCON

AutoEPCON is on schedule for April 27th, 2010.

MARCOM

Automotive Composites Conference

1. Already have 5 of 7 keynote speakers confirmed.
2. 22 paper offers submitted, 21 accepted, 1 paper in for review.
3. 15 early-bird sponsorships signed up by end of March.
4. 1st press release distributed – call for papers.
5. Fewer swap ads were negotiated with Media due in part to industry consolidation, fewer pages/editions.
6. Online registration for 2010 up and running.
7. Design of preliminary program guide pages completed.

IAG

1. Duplicate plaque orders processed (small surplus).
2. Gala & judging dates set: BOD judging Sept 30. & Oct. 1; Blue Ribbon Judging Oct. 11; and Gala Nov. 9.
3. Theme / tag line selected: *Speed, Innovation, Value.*
4. Permission received from Ford to use photo of Taurus SHO on event promotions.
5. Pre-event ads to go out in ~ 1 week (swap ads).
6. The Lifetime Achievement candidate nominations were reviewed.
7. The VETA (Vehicle Team Engineering Award) timing, recommendations and guidelines were discussed. Clarifications were proposed to the form, such as whether a presentation is required.

Web traffic:

The new site now has 2 years of content and the upward trend of traffic continued with a March volume of 20,750 unique hits.

Open Issues:

Discussed candidates nominated for Membership Chair, and other board positions.

New Business:

The motion to send flowers to Irv Posten was approved.

The ACC's request for permission to use IAG winter photos in a communications program highlighting innovation possibilities made possible through the use of plastics was approved.

Next Newsletter

End of May target.

Next Meeting

June 7.

NEWSFLASH: Nylon absorbs water.

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Decreasing VOC Emissions at the Source with New Additive Technologies for Olefin Composites

Louis W. Martin
Addcomp North America Inc.

Margareth Koppes
Addcomp Holland BV

Abstract

Fiber-reinforced olefin composites are widely used in a growing number of other industries for their cost- and weight-reduction opportunities and good balance of physical and mechanical properties. However, new pressures and regulations in the transportation and commercial and residential construction industries intended to improve "interior" air quality in Europe, Asia, and North America are spurring new research in additive technologies to reduce emission of volatile organic compounds (VOCs), odors, and fogging for polymeric materials.

Unfortunately, there are many pathways for the release of VOC emissions in molded olefin compounds, including residues left over from base resin polymerization, as well as from components used in the additive package itself. Much work [1-5] has already been done to help reduce VOCs, odors, and fogging in olefin compounds by addressing coupling-agent purity, which, ironically, has also been shown to help improve mechanical properties of the resultant compounds. Advanced coupling-agent technology – which sets new industry standards for purity, performance, and low additive levels – is now commercially available and has reduced VOCs several orders of magnitude in olefin compounds.

Since the pressures to improve air quality and reduce VOCs are increasing, past successes in one area will not allow a company to maintain market leadership by standing still. More work is clearly needed. The next logical step has been to try to reduce additional VOCs in other components of the masterbatch (primarily the stabilization package) by increasing the purity of components at the source. Some success has been achieved in this area, which will be reported in this paper, and a new low-VOC masterbatch has been developed.

However, there are still cases where VOCs cannot be eliminated at the source in components of the masterbatch – either because of the technical challenges involved or because the component is supplied by another company. In such cases, a third strategy is needed. One such approach has been to study the use of adsorbents and stripping agents during extrusion compounding of the masterbatch to capture and flashoff (in the case of stripping agents) or permanently bind up (in the case of adsorbents) VOCs and fogging or odor-causing emissions. This paper will report on the results of this latest research and discuss availability of new products that continue to evolve to meet evolving emissions standards.

Drive to Reduce Emissions & Improve Interior Air Quality

Since the 1970s, there has been a significant focus on improving indoor and outdoor air quality by governments and non-governmental organizations (NGOs) in the West.

In the automotive industry, the 2006, landmark report, "*Toxic at Any Speed*" (published by the Ecology Center, an NGO in Ann Arbor, Mich. [2]), brought to attention the importance of reducing VOC emissions in passenger-car interiors. The European Union has already enacted legislation (ISO/TS

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4 Power Distribution
Celstran® LFRT, Celanex® PBT, Vectra® LCP, Fortron® PPS

5 Cockpit Environment
Celanex® PBT, Vandar® PBT, Riteflex® TPC-ET, Hostaform®/Celcon® acetal copolymer

6 Underbody Skid Plates
Celanex® PBT, Celstran® LFRT

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8 Seating & Restraint
Hostaform®/Celcon® acetal copolymer, Celstran® LFRT, Riteflex® TPC-ET, Celanex® PBT, Vandar® PBT

9 Multi-functional Roof
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10 Instrument Panels
Celstran® LFRT

11 Speaker Grilles, Knobs, Handles and Levers
Hostaform®/Celcon® acetal copolymer, Celstran® LFRT, Celanex® PBT

12 Mirror Housings
Hostaform®/Celcon® acetal copolymer, Celanex® PBT, Celstran® LFRT

13 Wiper Plenums
Hostaform®/Celcon® acetal copolymer, Celanex® PBT, Celstran® LFRT

14 Lighting Housings
Celanex® PBT, Vectra® LCP, Fortron® PPS

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- Inherent flame resistance
- High strength and dimensional stability

Impet® Thermoplastic Polyester
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- Superior thermal and chemical resistance
- Toughness
- Rigidity
- Dimensional stability
- Wide temperature use range

Riteflex® Thermoplastic Polyester Elastomer
- Excellent toughness and fatigue resistance
- Outstanding chemical resistance
- Good low temperature impact
- Wide temperature use range

Vandar® Thermoplastic Alloy
- Excellent chemical resistance, ductility and stiffness
- High impact strength at low temperatures

Vectra® Liquid Crystal Polymer
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- High strength and modulus
- Broad chemical resistance
- Low mold shrinkage
- Excellent electrical properties
- Inherent flame resistance

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Decreasing VOC Emissions

Continued from Page 13

16949:2002 (automotive)) to reduce emissions and fogging in passenger-vehicle interiors by reducing emissions from individual components used in the cabin. Now the California Air Resources Board (CARB) is considering new legislation for the State of California – which, if enacted, will spill over to the rest of North America – on automotive cabin air quality. CARB already has rolled out standards around permissible emission levels for office furniture and similarly tough standards are expected in automotive.

Additionally, the building and furniture industries are facing their own set of national and international challenges with regard to interior air quality in both commercial and residential buildings. And architects and building owners who are trying to achieve Leadership in Energy and Environmental Design (LEED) credit for "*Indoor Environmental Quality, Materials and Resources: Recycled Content, Rapidly Renewable Materials, Low-Emitting Materials: Adhesives and Sealants, and Innovation in Design*" also are searching for products that enhance, not undermine, air quality.

Common Vectors for VOC Emissions

With increasing pressures from both governments and NGOs to reduce emissions and improve overall indoor air quality inside homes, offices, and automobiles, etc., there is tremendous interest among molders, resin suppliers, and additives producers in technologies that will reduce or eliminate emissions both during part production and during part use life. Unfortunately, the move to reduce emissions can affect other performance properties in a molded part and / or increase final-part costs. Further, there are many vectors in molded plastic parts for VOC emissions (*Figure 1*) depending on the base resin, molding process, and additives and reinforcement packages used to produce the part, as well as the type of decorative or functional treatments (e.g. primer, paint, paint films, adhesives, carpet, fabrics, etc.) applied to the part prior to installation in a vehicle, office, or home.

To simplify subsequent discussions, we will focus on the olefin family of thermoplastics, primarily on rigid, long-glass (>25 mm) thermoplastic (LFT) polypropylene (PP) in pelletized form and direct-LFT, which has been inline compounded prior to molding. Glass-reinforced PP is widely used in numerous industries to produce light, durable, tough, and attractive parts – many of which are used in building or vehicle interiors.

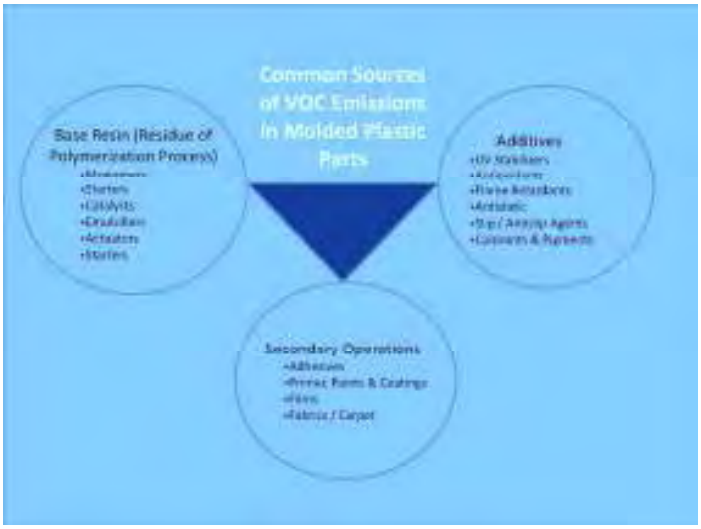

Figure 1: There are two major sources of emissions in molded plastic parts between compounding and molding: residue leftover from the polymerization process and components of the additives package used to enhance the performance of the base resin. Both categories of emissions are the focus of intensive research among resin and additives suppliers. Emissions may also derive from post-mold treatments like bonding and painting, which would represent a third vector for emissions.

Emissions from Polymerization Residues

For LFT-PP and DLFT-PP grades, a number of residual chemicals leftover from the polymerization process can contribute to outgasing, odor, and fogging, which in turn negatively impacts interior air quality. These include monomers, starters, catalysts, emulsifiers, actuators, and solvents. Reducing emissions from polymerization residues is an area of active work among resin suppliers and, as such, is outside the scope of this paper.

Emissions from Additive Packages

In addition to residues from the polymerization process, other source of VOC emissions in LFT-PP and DLFT-PP molded components can be found in the additives package itself, including UV stabilizers, antioxidants, flame retardants, anti-static and slip / antislip agents, and colorants and pigments – in other words, the very chemicals that extend the performance and improve the reliability and aesthetics of these compounds.

In the case of olefin composites, an important class of additives that enhance performance are coupling agents based on maleic anhydride (MAH)-grafted copolymers (MAGPO). These chemicals facilitate

better bonding between wood flour as well as glass and natural-fiber reinforcements and resin matrices, helping improve the stiffness, impact strength, and thermal performance of molded parts, essentially extending their use life [1].

MAGPO-coupling agents may also be used as a compatibilizer for immiscible polymers (e.g. as when nylon (polyamide) resins are accidentally or deliberately comingled with olefins during post-industrial or post-consumer recycling because they are used in similar applications or are subcomponents in larger assemblies, or to modify resin properties, or because the cost to source-separate is higher than the value of the combined resins).

As previously reported [1], the key to maximizing the effectiveness of these MAGPO-based coupling agents is to maintain high levels of molecular weight and grafting, while simultaneously decreasing the level of free MAH (in other words, increasing coupling-agent purity). Although these goals have been hard to achieve, a new generation of ultra-pure MAGPO technology has been shown [1-5] to provide a high level of molecular weight and grafted functionality (for high composite performance at low loading levels) yet has very-low levels of free MAH (several orders of magnitude lower than previous technologies, e.g. typically < 150 ppm vs. competitive products averaging 2,000 ppm – see *Figure 2*).

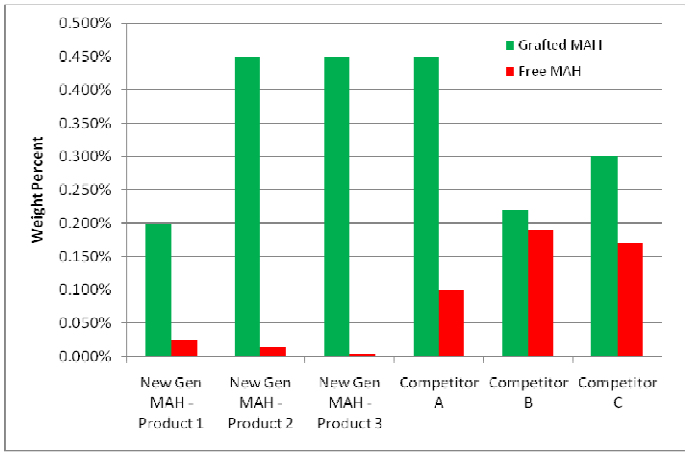

Figure 2: Three earlier generation competitive grades (right side) and three new-generation, ultra-pure grades (left side) of MAH coupling agents are shown in terms of grafted MAH and free MAH content. Higher grafting is desirable, but traditionally it came at a reduction in molecular weight and/or a rise in free MAH levels – both of which can lower interfacial strength between reinforcement and matrix in an olefin composite. The new-generation technology is produced differently, allowing very-high grafting levels to be achieved at very-low levels of free MAH. All products shown were used at an additive level of 0.6%.

These new products are manufactured via reactive extrusion in the world's only MAGPO production facility that has earned ISO/TS 16949:2002 (automotive) certification. During production, they undergo additional patented process steps that remove free MAH, creating ultra-clean additives. The resulting chemistry has been shown to produce the purest, most effective family of MAGPO coupling products used at the lowest additive levels and producing parts with the lowest odor and fogging on the market. These products are appropriate for use with LFT-PP, DLFT-PP, or short-glass PP or polyethylene (PE), as well as in natural-fiber or wood -flour-reinforced PP or PE grades. They are so pure that they also meet agency requirements for food contact in both North America and Europe.

The higher efficiency of the new formulations provides the opportunity either to improve current properties of an olefin composite by using the same dosing level as was done with earlier generation products, or the opportunity to reduce dosing levels (and lower cost) while maintaining the properties that were previously achieved. In either case, the environmental benefits of very-low free-MAH are maintained in molded parts whose additive package contains the new coupling agent.

Improving on Industry's Cleanest Technology

The new MAGPO coupling agents have been well received in the market and are starting to be incorporated in components that will be used in commercial automobiles, as well as in applications in other industries. Meanwhile, recognizing that pressures to develop even lower emission materials are increasing, and feeling that much had already been accomplished with the new MAGPO coupling agent, researchers have begun to investigate other ways to further modify additive packages for LFT-PP and DLFT-PP to help reduce levels of other emissions vectors previously mentioned.

The next step in the research program has been to try to reduce emissions from other components in the additive masterbatch that are under the control of the additive supplier. The approach taken has been to source products with lower emissions (higher purity) directly from their suppliers – a strategy that worked well with the coupling agent and has shown some success with other components. (More on this work will be discussed shortly.)

However, not all components that go into the additive package are under direct control of the additives

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supplier, and, even among those products that are, the current state of technology does not always allow emissions from such components to be reduced much below the currently industry level. (And contributions may also come from other emissions vectors such as the base resin itself or from post-mold treatments like paint, adhesive bonding, etc., which are completely out of the control of the supplier of the additive package.) In such cases where purer, lower-emission additive components cannot be acquired, an additional strategy for lowering the overall emissions of the additive masterbatch was needed.

One very interesting investigative path undertaken in 2009 focused on the inclusion of either stripping agents to remove or adsorbents to bind up residual VOCs left in the additive package during compounding with the base resin and subsequent molding. The balance of this paper will describe that work and the surprisingly results it has yielded.

Investigation Parameters

A preliminary study was conducted at Fraunhofer Institute for Chemical Technologies (Pfinztal, Germany) using DLFT-PP materials supplied by Dow Automotive (Auburn Hills, Mich., USA), 35% glass roving from PPG Industries (Pittsburgh, PA, USA), and additive systems produced by Addcomp Holland BV (Nijverdal, Holland).

All samples contained the same high-purity MAGPO-based coupling agent dosed at 1% by weight (previously identified as *New Generation MAH Product 2* on *Figure 2*). This grade is a commercially available product with a solid history of use. While it is not the purest of the new products (in other words, it does not have the lowest free-MAH level as do some developmental grades currently under evaluation), it represents proven technology and therefore seemed an appropriate choice given that other changes were going to be made in the additives package.

The samples also contained a stabilization package containing carbon black (for color) and an antioxidant stabilizer used at 1.5% by weight dosing level, although some formulations contained additions to this baseline stabilization system (see *Table I)*. A reference (control) formula (#1) used the standard stabilization package. Formula 2 featured an additional stabilizer (on top of the baseline product) that represents an older stripping-agent technology. Formula 3 was a lower VOC masterbatch created by sourcing purer components directly from suppliers and represents the strategy of source reduction. Formula 4 had a newer generation stripping agent added to the stabilization package. And Formula 5 had an adsorbent added to the stabilization package that absorbs and permanently binds with a wide variety of VOCs.

In all, five masterbatch compounds were formulated, inline compounded into the base resin, and

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Formulation	1	2	3	4	5
Difference	Control / Reference Masterbatch	Old Stabilization Technology	Lower VOC Masterbatch (Source Reduction)	New Technology 1:	New Technology 2:
Stabilizer	ADD-VANCE 453	ADD-VANCE 453	ADD-VANCE 757	ADD-VANCE 453	ADD-VANCE 453
Extra Additive	--	ADD-VANCE 47 with older stripping-agent technology	--	Stripping Agent	Adsorbent
Coupling Agent	PRIEX 20095	PRIEX 20095	PRIEX 20095	PRIEX 20095	PRIEX 20095
Resin/Glass	35% GR-PP	35% GR-PP	35% GR-PP	35% GR-PP	35% GR-PP

Table I: Formulation differences between the 5 additive masterbatches, which were subsequently tested for VOC & fogging and key mechancal properties. Formula 1 is the control; Formula 2 contains an additional (but older) stripping agent technology on top of the base stablization package; Formula 3 uses a low-VOC (source-reduced) stabilization package; Formula 4 features the addition of a new-technology stripping agent; and Formula 5 represents the use of a VOC adsorbent.

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compression molded into test plaques. Standard 8 x 2 x 2-mm test specimens were then cut from the plaques for each formulation and subjected to an ISO -standard VOC / fogging test (VDA 278) to see if the chemistry changes in the stabilization package had any impact on emissions from molded parts. Results of the testing are shown in *Figure 3.*

Additional mechanical tests were also conducted on each formulation to see if the changes made to the stabilization package affected other key properties as well. Results from tensile strength (ISO 527, sample width of 25 mm and cut in 00°/45°/90° directions to flow) and notched Izod impact tests (ISO 180 at room temperature and -40C) are shown in *Figure 4*.

Results of Testing

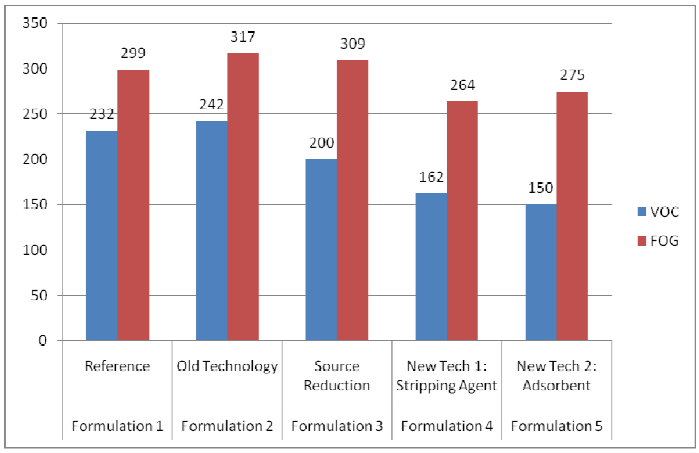

Figure 3: The new formulations (middle & right) generally showed improvements in both VOC and fogging vs. the baseline formulation (far left) and the formulation with the old stripping-agent technology.

Discussion

Despite the fact that all 5 of these formulations contained a new-generation, high-purity MAGPO coupling agent that had already shown significant reductions in free MAH vs. earlier technology, both VOC emissions and fogging results were further reduced from the baseline in all three of the new formulations (3, 4, 5) as shown in *Figure 4*. Formulation 2 with the old stripping agent technology was slightly worse in both VOCs and fogging even though it had represented the best technology at the time it was introduced. It seems to be less effective at removing VOCs from the masterbatch than the newer generation stripping agent. Interestingly, the

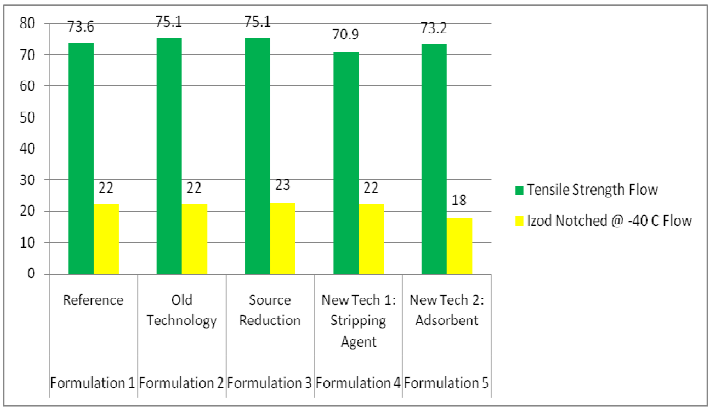

Figure 4: Tensile strength (in flow direction (MPa)) as well as notched Izod impact strength (at -40C (kJ/m²)) were also measured for all 5 formulations to see if there was a change in key mechanical properties of the molded parts.

low-VOC masterbatch (middle), which relied on source reduction via use of purer components, was slightly higher in fogging. This may be a test error or it may show an unintended interaction with other components of the additives package. However, this compound did show lower VOC emissions vs. the baseline. In general, the best results were obtained by stripping agent 1 (a newer stripping technology – Formulation 4) and the VOC adsorbent (Formulation 5), with the stripping agent being slightly better at reducing fogging and the adsorbent doing slightly better at reducing VOC emissions.

The new stripping agent used in Formula 4 was designed to bind up and remove non-MAH VOCs from the formulations by vacuum degassing during initial in-mold compounding of the DLFT-PP materials as shown in *Figure 5*. Therefore, its impact on emissions will be short-lived (it will only remove VOCs during compounding, not during molding or subsequent part life) but it will be achieved at a critical juncture where VOCs can more easily be controlled. There may be further ramifications to using this technology in a commercial compounding / molding operation, as not all extruders may be equipped with vacuum degassing. However, for applications where it is vital to be able to reduce VOCs, and in particular fogging, in the finished part, it may be worth the additional expense of adding this feature if it is not present on existing equipment.

The adsorbent used in Formulation 5 has a large capacity to bind with and permanently lock up a wide variety of VOCs on its surface. It is an inorganic, micro-porous, organophilic powder that stays well dispersed in the molded part, and will not migrate to the surface and volatilize off. Even if the polymer is re-melted, the adsorbent will not melt and has the potential to continue to bind with additional VOCs in

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Decreasing VOC Emissions

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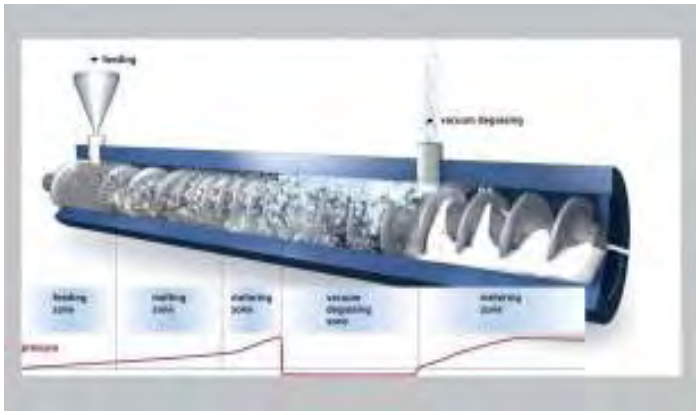

Figure 5: The two different stripping agents used in compounds 2 and 3 were designed to bind up and flash off free MAH residuals during extrusion compounding of the D-LFT charge prior to molding. An extra vacuum degassing stage is used to remove these emissions. In contrast to the stripping agents, the adsorbent was designed to persist in the compound after molding, which may provide the opportunity for it to bind up any residual MAH that might still reside in the compound.

the molded part. Because of this, researchers theorize that the adsorbent might have long-term VOC sequestering activity (beyond just initial compounding and molding), but further research will be required to verify this.

While the low-VOC masterbatch (Formulation 3) and both of the new technologies (Formulations 4 with the new stripping agent and 5 with the adsorbent) had previously showed improvements in VOC and / or fogging results vs. the control (Formulation 1), mechanical testing showed that only Formulation 3 (low-VOC masterbatch) experienced no degradation in these properties. There was a slight reduction in tensile strength on the adsorbent formula (#5) and a more significant drop in Formula .

Additionally, Formula 5 (adsorbent) showed a significant drop in notched Izod, indicating that the adsorbent (an inorganic powder) is affecting energy-management properties of the formulation. Interestingly, the two formulations that had done most poorly in the VOC / fogging test (old stripping agent and low-VOC masterbatch) actually showed a desirable increase in both tensile strength and low-temperature notched-Izod impact strength. This is most likely because the older, less effective technologies create fewer unintended interactions with the polymer matrix vs. the newer technologies. As so often is seen in plastics modification, making changes to improve one property can lead to negative changes in another.

The results of this experiment has shown that both source reduction and use of additional additives (new stripping agent and adsorbent) can yield further reductions in VOCs and fogging. The next logical area of research will focus on exploring if there are interactions between these three approaches when combinations of them are used in the same formula.

Yet another issue that needs to be addressed is to survey likely customers in multiple industries with pressures to improve interior air quality to see how valuable it really is to be able to continue to reduce VOC and fogging in these glass-reinforced PP composites.

Additional work that is already underway is an extension of the work mentioned at the start of this paper: a return to the MAGPO coupling agents to see if it is possible to increase grafting (which will increase mechanical performance of the compound) while simultaneously decreasing free MAH (which will further reduce VOCs and fogging). Initial results of this work look very positive (grafting was doubled and free MAH were further reduced). Tensile strength (in flow) and notched-Izod impact strength at -40C are shown in *Figure 6*. All formulations are 30% glass-reinforced PP with the baseline stabilization package used in the control formulation in the paper, but with three next-generation MAGPO coupling agents.

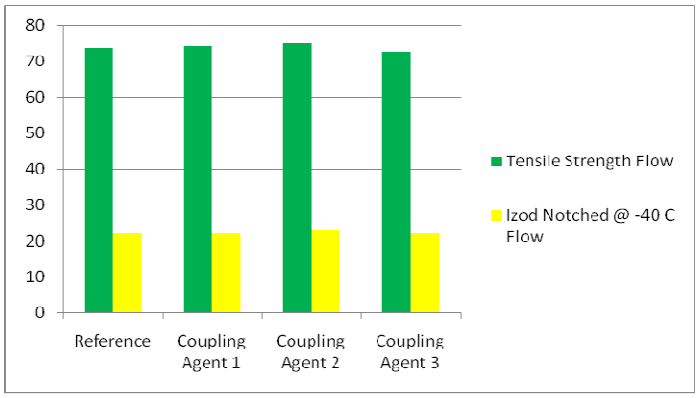

Figure 6: Additional work is underway exploring options to increase grafting of the MAGPO-based coupling agent (which increases mechanical performance of the resultant compound) while further decreasing free MAH levels (which lower VOC and fogging).

Best Formulations for Maximizing Performance & Minimizing Emissions

Previously investigations have shown the benefit of using the high-purity and ultra-pure MAGPO coupling agents in improving thermo-mechanical properties,

lowering dosing levels, and reducing VOC emissions and fogging. This latest study investigated how this coupling technology could be improved further by manipulating other components of the additive masterbatch – primarily by increasing the purity of components used in the stabilization package as well as adding either a stripping agent or an inorganic adsorbent to the stabilization package.

Preliminary results of this work seem to indicate it may be possible to reduce emissions further from the additives package via either source reduction or inclusion of a stripping agent or adsorbent. More testing may in fact show that when an adsorbent is used, that the ability to sequester VOCs continues for the life of the part.

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SPE® Issues Call for Scholarship Applications for Graduate-Level Research In Automotive Composites

Scholarships Application Forms Due July 21, 2010 for Two Awards to be Announced August 2010

The organizing committee for the ***SPE Automotive Composites Conference & Exhibition*** (SPE ACCE) announced today that it will again bestow two $2,000 USD scholarships for graduate-level research in polymer composites that has impact on ground transportation. Students interested in applying will find a *Scholarship Application* form available for downloading at:

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by July 21, 2010 for awards to be announced in August. Donations made by the ***SPE Automotive*** and ***Composites Divisions*** are funding this year's scholarships.

Winners will be selected from the pool of qualified applicants by ***SPE ACCE*** committee members and invited industry experts. Winning students will be required to report on the results of their findings during the eleventh-annual SPE ACCE, which takes place September 13-15, 2011. This is the fourth year conference organizers have offered these graduate scholarships.

In 2009, awards were presented to **Gregorio Manuel Vélez-García**, a Ph.D. candidate at **Virginia Polytechnic Institute and State University**, whose work is focused on *Development of a New Method for Predicting Fiber Orientation in Fiber-Reinforced Injection-Molded Thermoplastics*, and to **Zeba Farheen Abdul Samad**, a doctoral candidate at the **University of Illinois-Urbana/Champaign** whose work research topic is *Novel Aromatic Thermosetting Copolyester (ATCP) / Carbon Fiber Composites*. Students will present the results of their research at the tenth-annual SPE ACCE, September 15 and 16, 2010.

In 2008, the winners were **Uday Sharma** of **University of Michigan-Dearborn**, whose topic was *Analysis of Thermoplastic Woven Composites at High-Strain Rates*, and **Tobias Potyra** of **Fraunhofer Institute of Chemical Technology**, who worked on *New Direct Processing Technology for the Manufacture of SMC Parts (Direct-SMC)*. The first scholarships were given in 2007 and were made in honor of journalist and composites-industry insider, Steve Loud who passed away in 2006. The recipients were **Roston Elwell** from **Texas A&M University** for research on the *Use of Active-Core Composite Sandwich Panels for Improved Automotive Safety*; and **Alejandro Londono-Hurtado** from **University of Wisconsin-Madison** whose work involved *Simulation and Numerical Modeling of Fiber Orientation and Density Distribution During Molding of Fiber-Reinforced Automotive Parts*.

Held annually in suburban Detroit, the ACCE provides an environment dedicated solely to discussion and networking about advances in the automotive composites industry. The ACCE typically draws over 400 speakers, exhibitors, sponsors, and attendees from 14 countries on five continents with fully one-third indicating they work for an OEM involved in automotive, heavy truck, off-highway, agriculture, or aerospace/ aviation. 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 and who represent transportation OEMs and tier suppliers, composite materials, processing equipment, additives, and reinforcement suppliers, trade associations, consultants, university and government labs, media, and investment bankers. The show is sponsored jointly by the SPE Automotive and Composites Divisions.

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This year's show, which will be held **October 3-6, 2010** in the Detroit area, will feature special sessions on Thermoforming, Polypropylene Compounds, and TPEs and TPVs to help OEMs and molders improve their competitive advantage in the global market.

Enjoy Exceptional Global Networking Opportunities

The ***SPE Automotive TPO Global Conference*** typically draws over 400 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 with global leaders in materials, processing, and application development.

Olefins: Among the Most Versatile & Fastest Growing Polymer Families

For more than a decade, polyolefins have been the fastest growing segment of the global plastics industry. Their excellent cost / performance ratio have led to wide adaption in the automobile in applications ranging from semi-structural composite underbody shields and front end modules to soft-touch interior skins and bumper fascia. In recent years, the olefin supply chain has experienced major restructuring, which is now providing both challenges and opportunities for OEMs and the entire supply community. Attending the ***SPE Automotive TPO Global Conference*** is an excellent way to keep up-to-date on this rapidly changing market and technology offerings.

To learn more about the show, see the latest conference updates, or to register, please visit www.auto-TPO.com or www.speautomotive.com/tpo.htm.

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