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SPE AUTOMOTIVE

AUTOMOTIVE PLASTICS News

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9th-annual AUTO EPCON Recap

A Record 2014 SPE® AutoEPCON

by Terrence Q. Cressy and Dr. Gary J. Kogowski

The ninth-annual SPE AutoEPCON, held on Tuesday, May 6th at Michigan State University's Management Education Center (MEC) in Troy (Detroit), Michigan USA, set records for registered attendance (270), number of presentations (27 regular technical talks plus four executive keynotes), and sponsorship support (33 sponsors, 22 of which also exhibited).

Pete Grelle, president of the SPE Detroit Section called the conference an outstanding event in every respect. This year's efforts were led by Kathy Minnich of Ford Motor Co., who served as executive chair, and the organizing committee headed by co-chairs, Gary Kogowski and Sandra McClelland. "The conference is the only one of its kind focused on engineering plastics and the issues that propel and challenge plastics industry growth," Grelle added. "The conference proceeds will make a big impact on the educational programs of both SPE's Detroit Section and Automotive Division."

Continued on Page 4

CONTENTS

AUTOMOTIVE DIVISION MEETING SCHEDULE & SPECIAL EVENTS CALENDAR

SPE AUTOMOTIVE

Auto. Div. Board Meeting
American Chemistry Council - Auto. Ctr. — 5:30 - 7:30 pm
Troy, MI USA — June 23, 2014

SPE Social Event
GM Heritage Center Tour & Networking Reception
GM Heritage Center / Rosie O'Gradys — 3:00 - 7:00 pm
Sterling Heights, MI USA — June 25, 2014

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

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

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

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

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

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

Automotive Division Board of Directors meetings are open to all SPE members. All events are listed on our website at http: speautomotive.com/ec

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

CHAIR'S MESSAGE

by Yvonne Merritt
2013-2014 SPE Automotive Division Chair

Fellow members,

The long-awaited spring has finally arrived here in Detroit! As the flowers are blooming and the trees are sprouting new buds, with this time of year comes new growth and change. My term as the SPE Automotive Division chair is soon coming to an end. The time has definitely flown by but, as with every year, I think the our organization has accomplished its goals of increasing knowledge about current and future automotive plastics applications through its technical conferences and educational outreach programs.

Most recently, we co-hosted SPE AutoEPCON with the Detroit Section and in late April, the Automotive Division hosted a two-part session at ANTEC in Las Vegas, Nevada. Thank you to Anthony Gasbarro and Suresh Shah for coordinating and moderating this session. At this conference, the Automotive Division also received the prestigious Pinnacle Gold award for our successful work in delivering member value in the previous year. Here is a thank you to Vince Holmes, incoming Automotive Division chair, for submitting our application, which can be somewhat tedious to fill out.

I would also like to take the opportunity to thank Peggy Malnati for ALL of the work she does for our division. Not only does she do the marketing and communications for many of our events, manages and updates the website, organizes, and edits and publishes our quarterly newsletter, but she was also key in getting our tax filings completed and up to date. Peggy has been instrumental in keeping the division in check and helping me perform my duties as chair. I can't thank her enough for everything she's done. I would also like to thank Dawn Stephens for her help with managing the Automotive Division office at ACC, helping us with the *Quickbooks* and *PayPal* setup, and recently assuming the role of treasurer. It was a great relief to be able to transfer those responsibilities to someone else!

I would like again thank Steve VanLoozen and the rest of the Membership Committee for their successful efforts to increase membership in our division. Based on the results of our recent membership survey, we confirmed that the benefits of being a part of SPE are valued both by individual members and members' employers as well.

And lastly, I would like to thank members of the Automotive Division board for all of their time, energy, ideas, and, most importantly, agreement during the last year. Your help and dedication makes this division what it is today. It has been a pleasure working with all of you.

Please join us at our next social event as we tour the General Motors' Heritage Center on Wednesday, June 25th. Details are provided later in this newsletter and will be communicated via upcoming eBlasts.

I welcome Vince Holmes of Charter Prime Alliance who will assume the position of chair of the Automotive Division as of July 1st. Have a safe and enjoyable summer!

Sincerely,

Yvonne Merritt

2013-2014 SPE Automotive Division Chair
Ford Motor Co.

AutoEPCON CONTINUED FROM PAGE 1

This year's we had five technical sessions: New Materials, Lighting for LEDs and Laser Marking, the Plastics Industry Automotive Roadmap, Advanced Material Applications for Powertrain and e-Mobility, and Bio-based and Recycled Resin Advances in Engineering Materials. For a second year, session moderators were students from local universities (Kettering University, Michigan State University, Saginaw Valley, University of Massachusetts-Amherst, and the University of Michigan) with the participation of SPE board member mentors.

A highlight of this year's conference was the four executive keynote addresses. The morning lead-off presentation was by Eric Fedewa, director, Global Component Forecasts and Analysis, I H S Automotive. His presentation moved from the outlook for 18-million unit vehicle production in North America to the possibility of 100-million units a year worldwide in the not-too-distant future. He discussed the progress toward autonomous (self-driven) vehicles, and energy landscapes with diesel and electric propulsion in the lead to the possibility of gasoline being viewed one day as a useless refinery by-product.

Dr. Ashish Kulkarni, chief innovation officer for Celanese Corp., spoke of the paths of evolutionary and revolutionary growth and innovation in engineering plastics, only limited by what's possible from utilizing the full periodic table of the elements.

Dr. Bob Powell, technical fellow and lab manager of the General Motors Co.'s Battery Systems Group addressed "Automotive Lightweighting - Now More than Ever." He sees concurrent use of fossil fuels and alternative propulsion such as for electric vehicles (EVs) and fuel-cell vehicles. He pointed out that each technology faces challenges, including increased mass from battery packs that can range from 400 lb (181 kg) for the *Chevy Volt* to 600-1,200 lb (272-544 kg) for current battery EVs (BEVs).

Ankil Shah, general manager for materials engineering, Toyota Engineering and Manufacturing - North America, traced the development and reasoning for increased use of plastics in automobiles, "Past, Present and Future." He noted that plastics have increased to 10 percent of average vehicle weight, while steel has declined in recent years. He challenged thermoset suppliers to work on improving manufacturing cycle times (carbon fiber composites) and for thermoplastic resin suppliers to continue efforts to reduce part creep and stress relaxation as well as improve performance at very-high heat-aging temperatures.

Kathy Minnich encouraged attendance, sponsorship, and technical presentation development efforts for future conferences. "We all have time and resource limitations," she added, "but the investment of extra time and effort is well worth it in building a broader perspective to understand and tackle future industry challenges."

The 2014 SPE AutoEPCON conference committee would like to thank each of the conference speakers, presenters, attendees, and those companies who sponsored the event. We look forward to seeing you at the 2015 SPE AutoEPCON conference.

BATTER'S BOX
Guest Columnist, Susan Hill

New Tensile Test Standard for Filled Polymers in Development, We Need Your Help to Go Forward!

by Susan I. Hill, Group Leader - Structures and Material Evaluation Group, Structural Integrity Division, University of Dayton Research Institute

The automotive lightweighting landscape is continually changing and growing as carmakers strive to produce more efficient vehicles that adhere to strict U.S. government Corporate Average Fuel Economy (CAFE) standards. However boosting efficiency isn't the only challenge. In shedding pounds to increase miles per gallon (kilometers per liter), the auto industry must also maintain vehicle safety for drivers and passengers. No small feat. Achieving this comes down to material choices – specifically we are thinking advanced plastics and polymer composites, am I correct?

Plastics are lightweight by nature, and by themselves can be quite strong (see http://www.plastics-car.com/Blog/Lightweighting-in-Cars-One-Weird-Chart-That-Should-Convince-Auto-Makers.html). However, as you know, there are ways to make plastics even stronger, by reinforcing the matrix material with various fibers, including chopped or continuous filaments, rovings, or fabrics of natural fiber, fiberglass, carbon fiber, basalt fiber, or even nanofibers. Like rebar in a cement pillar or the weave of threads in cloth, reinforcing resin with fibers provides added stiffness and strength. What's next for fiber-reinforced polymers for use in automotive parts? Crucial research. But there's one thing standing in the way: **there is currently no industry-accepted standard specimen configuration or procedure for high-rate tensile testing of fiber-filled polymers.**

Without a standard, testing is essentially self-serving. In order for research and testing to fulfill its purpose and facilitate the increased use of fiber-reinforced polymers in car parts, we must set standards for generating material properties for plastics with fiber. **To do this, we need your support.**

The American Chemistry Council (ACC) and the University of Dayton Research Institute (UDRI) are now spearheading an effort to develop a high-rate tensile test standard for fiber-reinforced polymers. This effort is slated to begin with a kick-off meeting involving those in industry, government, and academia who use, generate, or apply high-rate material property data. The meeting is planned for **June 5, 2014 in Troy, Michigan.**

ACC and UDRI have arranged the research for the industry. **Now we need those who have an interest in supplying the automotive value chain to speak up, participate, and perhaps test some of their components.**

UDRI will serve as the key technical contact to organize and help establish a group of committed and interested parties to support development of the standard. The University of Dayton (UD) and UDRI have a long history in materials, structures, and mechanical systems research. In fact, the Structures and Materials Evaluation Group of UDRI (SME-UDRI) was previously funded by the ACC to develop a high-rate tensile specimen that would be suitable for fiber-reinforced polymers. SME-UDRI was successful in identifying

Batter's Box CONTINUED FROM PAGE 6

key requirements for proper measurement of the tensile mechanical properties and determined the mechanical properties of fiber-reinforced polypropylene at nominal rates up to 500/s.

However, the consortium that developed the high-rate tensile standard for unfilled polymers (SAE J24749) recognized that there were three significant concerns with the geometry in the high-rate standard:

I) The effect that the geometric transition from the tab-to-gauge portion of the specimen and the molding conditions have on the distribution and orientation of fibers in long-fiber reinforced polymers (or long-fiber filled polymers);

II) The stress state in the gauge area and the stress concentration at the specimen radius;

III) The length of the fibers relative to the specimen gauge length, width, and thickness.

Now ACC and UDRI are leading an effort to expand the SAE J2749 standard to include fiber-filled polymers. UDRI will serve as the facilitator at the initial meetings to help identify the concerns and needs of the industry, to define the scope, and establish the phases to achieve the standard. Now more than ever, **your input is needed. Please help us to define the scope of the effort and identify those who are willing to commit to the development of the standard.**

Will you join me at this meeting? What you'd stand to gain is a major impact on the safety and efficiency of the cars of the future. A revolution is coming to the auto industry, by way of fiber-filled polymer composites, that will open up the landscape for automobile *lightweighting* without sacrificing vehicle safety. **And you can be a part of it. Contact me if interested in participating.**

If you're interested in contributing your time and expertise to facilitating strong yet lightweight car parts by helping to develop high-rate tensile testing standards for fiber-reinforced polymers, **contact me today** for additional information and for details on how you can get involved. **The future of fiber-filled polymers in car parts now depends on you.**

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http://www.udri.udayton.edu/ContactUs/People/Pages/SusanHill.aspx

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ABOUT SUSAN HILL

Susan Hill joined the Structures and Materials Evaluation group in 1995. Her research activities include evaluating polymeric, ceramic, composite and metallic components for automotive and aerospace service environments, designing experiments, and failure analysis. Much of her recent work has focused on the determination of high strain rate effects on material and component properties. Management of several simultaneous programs and contacts with commercial and government agencies is an integral part of her job. She has a thorough working knowledge of American Society for Testing and Materials (ASTM) and Suppliers of Advanced Composite Materials Association (SACMA) specifications. Prior to working at UDRI, Ms. Hill worked at the General Electric Company in the Aircraft Engines and Lighting Business Groups. She has a varied background in manufacturing, materials development, process engineering, and applied research. Her research and engineering activities included ceramic process development, superconducting wire and polymeric composite materials development, metals fabrication, generating design allowables data, and managing interdepartmental test programs. She holds an M.S. degree in Materials Science from Case Western Reserve University and a B.Ch.E. in Chemical Engineering from University of Dayton.

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Now in its 16th year, the show is the world's leading automotive engineered polyolefins forum featuring 60+ technical presentations, keynote speakers, networking receptions, & exhibits that highlight advances in polyolefin materials, processes, and applications technologies as well as a growing range of thermoplastic elastomers (TPEs) and thermoplastic vulcanizates (TPVs). This year's show will be held Oct. 5-8, 2014 at the Troy-Marriott (Troy, Michigan) in the suburbs of Detroit.

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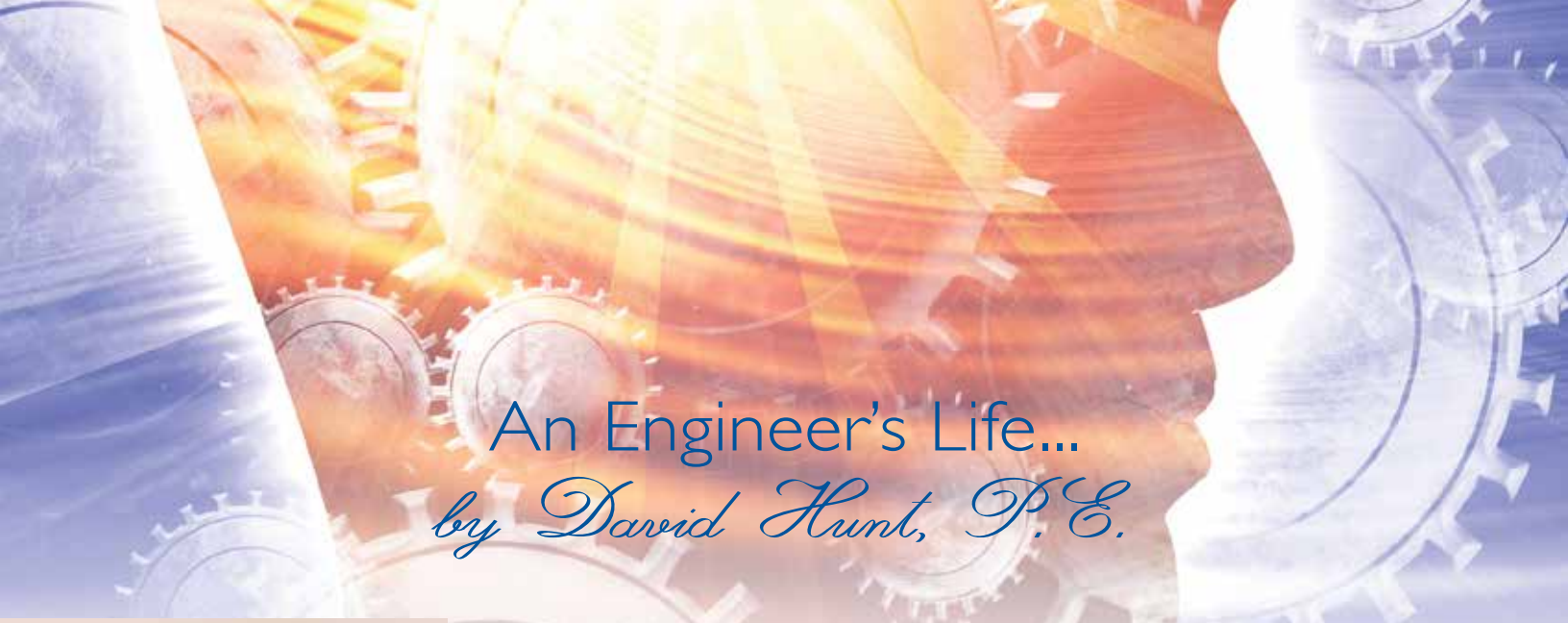

An Engineer's Life...

by David Hunt, P.E.

I was always scientifically and mathematically inclined. Some of my earliest memories are of growing mold on a piece of bread (deliberately); building towers out of blocks and trying to make them be both tall and strong (not understanding the concept of trade-offs); and arguing about the concept of infinity with a fellow preschooler (with me hopping mad that my fellow student said "infinity plus one").

In elementary school I joined the after-school science club. We distilled water, looked at onion cells under a microscope, and – surreptitiously – I tried to make gunpowder…unsuccessfully. In high school I took a science class every semester, and doubled up on classes my junior year. When the space shuttle launched, I swore I'd be on one someday, even if I had to super-glue myself to the outside. To that end I made my own solid-fueled rocket, and test-fired it nose-down in the ground in our backyard. The white-hot flame sparked several feet in the air, and that prompted a call from our concerned neighbors to my parents, thereby shutting that project down but quick!

In college I started out majoring in Physics and Math and — after a year off — I took a turn from pure science to Mechanical Engineering…and I haven't looked back.

I love designing things. I love developing new technologies – I have two patents, with a third in process. I love solving problems; there's nothing finer professionally than working one's way through possibilities. It's a spine-tingling thrill when you have a "left-field" idea… and it works. Whether solving a design problem and coming up with a solution that's never existed before, or wending your way through the possibilities generated by analyzing a process issue with an Ishikawa/Fishbone diagram, it's an exercise in creativity. It's like a good mystery novel, except you can't flip to the back of the book to see if the butler did it… you have to work your way through it step by step. But – ah! – the delight when all the pieces fall in place and you know you've found the solution.

"ONE WORD… PLASTICS"

I got my start in plastics when I was studying at the University of Massachusetts at Amherst for my Bachelor's degree. "The buzz" was that having a co-op experience under your belt would be useful when looking for work after graduation, and U Mass had an excellent co-op program. I applied for two positions figuring that I'd get one offer. One was with Pratt & Whitney working on jet engines; they had a project trying to develop non-contact measurements for turbine blades. The other was with GE Plastics at their headquarters in Pittsfield, Massachusetts. To my surprise both made me an offer, but GE's was better monetarily, so I chose them for purely mercenary reasons.

I was told I'd be doing some design work including a lot of finite-element analysis (FEA). Cool! And work I did… my main project – a set of panels forming a box for processing cheese curds – ended up with the nickname "cheese box from hell," as every design iteration got closer to, but never actually met the design specifications. It seemed impossible to meet, but finally we crossed the threshold and met the spec. Another project involved a failing injection-molded filter housing. My redesign solved the fatigue-cracking problem.

An Engineer's Life CONTINUED FROM PAGE 10

ONWARD AND UPWARD

After graduation I got a job at a startup in the Detroit area. I was actually recommended to this company by my former boss at GE. He wanted to hire me, but they had a hiring freeze at the time. Again, I was doing design and FEA work in plastics, this time in an automotive setting. Alas, the parent companies decided to pull the plug. I transitioned to another company looking to develop its own in-house plastics expertise… but two weeks after starting that job, I got the news that I'd been accepted to Carnegie Mellon University to get a Master's degree in Mechanical Engineering – and had been awarded a full scholarship with a stipend. Given a choice of staying where I was or attending a name school under these conditions, I jumped at the latter.

Since then I've worked for a resin distributor, for Ford Motor Co. and its spinoff, Visteon, and others. I've worked in plastics, I've worked in electro-mechanical equipment, and I've designed high-temperature chemical reactors. In each instance I've designed, problem-solved, and had significant accomplishments.

In 2012 I left a job at a chemical company for a chance to go to a "bleeding-edge" R&D company. Unfortunately the culture and I were mismatched, and I didn't last long. I had heard rumors about the culture, but didn't investigate in depth before I jumped. That proved a big mistake and one that I'll never make again. To stay active while I look for full-time work, I have done some consulting, and have a part-time contract job. The free time has permitted me time to start a blog (http:// davidhuntpe.wordpress.com) where, among other topics, I've been revisiting some of my accomplishments. One of my goals for the blog is to show that I do, indeed, know what I'm talking about, at least engineering-wise.

A MASS OF CONTRADICTIONS

We engineers are a strange lot, full of contradictions.

We love to be "on the edge" of doing things that nobody's done before. Yet as we push the envelope of what's possible, our risk aversion shows through with ever-increasing factors of safety to account for all the "unknown unknowns" inherent in walking that bleeding edge of development.

For example, as a champion of Lean Manufacturing for a while, I learned about minimizing work in progress (WIP), but in my own life I've often found the philosophy of "better to have it and not need it, than need it and not have it" overwhelming the lessons of Lean I was practicing at work.

Yet the concept of risk probability-times-consequences that I learned while doing failure modes and effects analysis (FMEA) has rung true in my life as well. Living for several years in a city, the power had gone out several times. However, being near the center of town, it always came back on quickly, even after a couple of bad ice storms. Now that we live in a rural area, we have a backup power source. The risk of a power outage from a storm is roughly the same in either location, but being where we are now, the consequences – a week or more without power – drove the decision to invest in an automatic-on, propane-fueled generator.

FOR WHAT IT'S WORTH

So what specific advice can I offer to other engineers? Here's a "Baker's Dozen" list.

1. Take classes. Get certifications. Pursue an advanced degree. Work to increase the value you give to your employer by continually improving yourself.
2. Network, network, network. Build a network of people whom you know personally by going to society events, and make sure these people are in other companies. And when I say "stay in touch" I mean it – touch everyone in your network on occasion with an email, a relevant article, or a casual lunch. Devote at least 30 minutes a day to doing this. Ultimately, it's your reputation – whether in person or on social media – that will help you in multiple ways. And speaking of social media, never "share" anything you wouldn't want to have to explain to your kids.
3. Help others. Assist others at work; volunteer professionally and personally. Giving comes back to you – in contacts, in self-worth, and in knowing that someone else's life is better because you made a difference.
4. If you're introverted, work to overcome it. Join Toastmasters. Become skilled at "small talk." Fake being an extrovert until you actually become one. On the flip side though, don't be gabby, don't gossip, and remember the adage, "You have two ears and one mouth to listen twice as much as you talk."
5. Be loyal, but only to a limit. Work is an economic exchange. You exchange your time and skills for a paycheck; your employer expects you to solve problems. However, there are myriad factors beyond your control, and even the best of employees can be cut loose when economics or politics

An Engineer's Life CONTINUED FROM PAGE 11

demand it. Protect yourself; keep your resume updated. Have a list of target companies where you'd like to work if your current job goes south.

6. Balance taking a stand when you're right with being conciliatory when you're not so sure. You're human; you will make mistakes – admit them, as it's better than having someone else point them out. And nobody likes a know-it-all, even if you are right: be humble and respect everyone – from the CEO to the janitor.
7. Don't burn bridges. If you find a better job, be sure to leave on pleasant terms.
8. Have a life. I know people whose lives are consumed by work and casual-overtime allegiance to an employer. Some day they will wake up and wonder where the years have gone. Doing a good job is important, but you are more than your career. I guarantee that on your death bed you won't wish you'd spent more time at work.
9. Take care of yourself. Exercise and eat right. It may be convenient and expedient to have pizza… mmm, pizza… as a staple in your diet. However, that carries a price.
10. For younger engineers especially, "Don't fish in the company pond." You spend a lot of hours at work and the temptation might be to date a co-worker. Rarely does good come of romance in the office. (And affairs can prove to be an order-of-magnitude worse.)
11. Especially if you are young and single, take every opportunity to travel for work. Take a field-service job at least once. Take a foreign assignment if you can. As a part of that experience, learn about other cultures and try to learn other languages.
12. Read, and read widely. Study history, other cultures, poetry, and classical literature. Go to plays and visit art museums. Culture is not a waste of time. Learn to write, and not just technical writing.
13. Lastly, call, write, and visit friends and family often. You just never know when they might not be here anymore. I am haunted, to this day, by my walking past my elderly cousin John's apartment, thinking I'd visit him another day…he died that night.

Would I change things about my career and life if I could? Sure, but it'd be in the details, not in the basics. I love engineering. Creating what never was before brings me joy. And that's what I'm looking for in my next job – the chance to create new things and add value to my employer, while having time to savor my family and interests too.

ABOUT DAVID HUNT

David Hunt is a Mechanical Engineer with a background in multiple industries, but predominantly in the plastics industry. Currently "in transition," Hunt blogs at davidhuntpe.wordpress.com both as an outlet for his love of writing and to draw attention to his knowledge, skills, accomplishments, and wide-ranging intellectual curiosity. He can be reached at davidhunt@outdrs.net.

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Service through Science

by Dr. Allan Murray

Chief technology officer, Allied Composite Technologies LLC

I grew up in a suburb of Vancouver, British Columbia in Canada. In the post-Sputnik era, Canada made it easy and inexpensive to go to college, and I was the first person in my family to have the opportunity to attend. My father, although he had little formal education, designed and built "professional-quality" electronic organs as a hobby. He was a fantastic woodworker too, making beautiful enclosures for these organs. While he was self-effacing to a fault, he established lofty goals for me by example.

I was lucky to be chosen for my high school's first accelerated academic program (four years in three), which required that I hold my own among very bright classmates. Learning how to compete with and not be intimidated by bright people became very important in college and later in the work environment. I chose engineering rather than science in college because an excellent advisor asked me a key question at the right time: "Do you prefer to work more with your hands or with paper?" I'd enjoyed woodworking and metalworking in high school, so I said I liked to work with my hands. Thus he recommended engineering rather than science, and I agreed even though I didn't really know at the time what an engineer did.

Vancouver was an important center in Canada for the mining and metallurgical industries, and the University of British Columbia (UBC) had an excellent metallurgy school, so Metallurgical Engineering was a logical choice for my major. Although I didn't realize it at the time, this was a fortuitous choice because metals and materials really do "make the world go around," so we need to have a deep understanding of the behavior of materials to do just about anything.

While I was a student at UBC, I had the opportunity to take field trips and to see what typical graduate metallurgists did. It wasn't a pretty sight – dirty jobs in dingy, remote locations. Because of that, I decided to go to graduate school to study metallurgy and materials science, and I chose Carnegie Mellon University in Pittsburgh. Pittsburgh was the center of the steel industry, and Carnegie Mellon had an excellent metallurgy school. While trying to choose my doctoral thesis topic, it became clear to me that the steel industry was undergoing a serious, perhaps fatal, recession. One of my professors got me interested in polymers and plastics, so I did my Ph.D. thesis on understanding the viscoelastic behavior of semi-crystalline polymers.

Upon graduation in 1970 I had opportunities with several chemical and plastics companies, but I chose to join Ford Motor Co.'s Research Labs in Detroit, because they were gearing up to replace steel with plastics and composites. Besides, Detroit seemed to be on the path back to Vancouver from Pittsburgh. So began an exciting 31-year career at Ford trying to do just that. Now, almost 45 years later, except for visits, I never quite made it back to Vancouver, and the effort to replace steel with composites still has a long way to go.

Shortly after I started working at Ford, the company established a Plastics Development Center (on Glendale Ave.), which I joined. My first project there was to develop what we called thermoplastic stamping – rapidly forming of plastic parts in matched-metal tools. This process was of interest to Ford's Metal Stamping Division because at that time they were concerned that plastics would take away much of their business. After seemingly endless cost and validation studies, they implemented plastic stamping at the Maumee, Ohio stamping plant, and produced lightweight plastic fender liners in very high volumes for many years. This process won an SPE Automotive Innovation award in fact. I was soon promoted to run the Advanced Manufacturing and Product Development Department at one of Ford's plastics manufacturing plants, which helped hone my manufacturing skills.

Next, I was back again at the Glendale center where I led the development of more automotive plastics products, including the all-thermoplastic *(Xenoy)* bumpers for the Taurus and many other vehicles — another application that won an SPE Automotive Innovation award). In the coming years, I was also involved in

 CONTINUED FROM PAGE 15

the development and commercialization of plastic body panels, pickup truck composite boxes, composite front ends, and lots more. Eventually, that led to my running the Glendale Plastics Development facility and interfacing with operations around the world, including with our sister automaker, Mazda Motor Corp. in Japan.

Prior to my retirement from Ford in 2001, I was Ford's technology head for the Partnership for New Generation of Vehicles (PNGV), a collaboration of the U.S. federal government, its national labs, and the U.S. Big Three automotive companies to develop technologies for major improvements in fuel efficiency. In this position I was able to help focus the development of many key technologies that are just now finding their way into mainstream automotive applications, including lightweight materials, battery and fuel cell technologies, new power electronics, and advanced engine technologies. As before, my materials, manufacturing, and general engineering skills (even thermodynamics!) proved to be of considerable value in these efforts.

My automotive career was always fun and challenging, but also frustrating, trying to overcome the many hurdles placed in the road by a very risk-averse and "steel-oriented" automotive industry. It became clear that more time and resources were spent convincing others to get to a *"yes"* (we'll try this on one of our vehicles) answer in the automotive industry than were spent in developing the technology in the first place.

Lacking adequate golf skills, my retirement from Ford lasted about one month. I began consulting for several companies as well as several of the national labs (Oak Ridge National Laboratory and Pacific Northwest National Laboratory), identifying and helping direct the development of technologies with automotive potential.

About six years ago I formed Allied Composite Technologies (ACT) with long-time associates Tom Russell and Fred Deans. ACT identifies and integrates advanced technologies, including high-performance thermoplastic composites to address industry needs. We focus on recreational vehicle, infrastructure, sporting goods, and other non-automotive industries because they tend to be more receptive to new technologies, and faster to implement new ideas.

One example of the technologies ACT has been pursuing is incorporating polyethylene terephthalate (PET) from recycled pop (soda) bottles with continuous-strand, oriented glass fibers to produce very stiff and strong thermoplastic composites. We demonstrated the use of a very low-pressure forming process to make large vertical-axis wind turbine sails from this composite material – thus creating green energy through the use of green materials.

Although the automotive industry remains highly risk-averse – mistakes are very costly – I now see a very positive improvement in its receptivity to new technology, probably due to increasingly tough new regulations and increased awareness of the need to compete globally to survive. Perhaps more than ever, it is a great time in the automotive industry for the application of materials engineering and science.

ABOUT ALLAN D. MURRAY

Dr. Allan D. Murray is president of EcoPlexus Inc., and chief technology officer of Allied Composite Technologies LLC. He is an experienced senior manager of research, manufacturing, and product development who successfully guided many advanced products and technologies from concept through production during his 31 years at Ford Motor Co. He has an in-depth understanding of materials and processes, and extensive experience in technology collaboration. He was Ford's technology director for the Partnership for a New Generation of Vehicles (PNGV), a government / industry initiative established to develop affordable fuel-efficient vehicles. In this position he led government / industry teams researching a wide range of technologies including lightweight materials, advanced vehicle construction, powertrains, fuel cells, batteries, and power electronics. He also served as chair and president of the non-profit Michigan Materials and Processes Institute (MMPI), which sponsored collaborative university / industry materials research. He holds a Ph.D. in Metallurgical Engineering and Materials Science from Carnegie Mellon University and an MBA from Wayne State University. He serves as a judge for the annual *Automotive News* PACE automotive supplier innovation awards. He is a fellow and honored service member of SPE, and was honored in 2011 with the Lifetime Achievement Award from the the SPE Automotive Division.

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DIAMOND CENTER

SPE® Issues Call for ACCE Scholarship Applications; Michigan Economic Development Corp. Returns as Sponsor

PURE MICHIGAN®
Michigan Economic Development Corporation

The organizing committee for the ***SPE® Automotive Composites Conference & Exhibition (SPE ACCE)*** today issued its call for student scholarship applications and announced that Michigan Economic Development Corp. (MEDC, Lansing, Michigan, USA) is returning as sponsor of two $2,000 USD historic SPE ACCE graduate scholarships (given annually since 2007) plus a new $2,000 USD scholarship for an undergraduate or graduate student enrolled in a Michigan educational program (first given in 2013). Applications for all three scholarships are due **July 20, 2014** and forms can be found at **http://speautomotive.com/comp.htm**. Winners will be selected from a pool of qualified applicants and announced in early August 2014 before this year's SPE ACCE show.

"Michigan's future as the global leader in automotive and manufacturing innovation and new technologies depends on engineering talent," says Nigel Francis, MEDC's senior vice president, Automotive Industry Office. "The MEDC is committed to ensuring that industry has the pipeline of talent it will need for the future. SPE's Automotive Composites Conference and Exhibition is an event that focuses on both the current and future needs of one of Michigan's most important industries. Every dollar that we invest in these engineering scholarships is an investment in Michigan's success in the future."

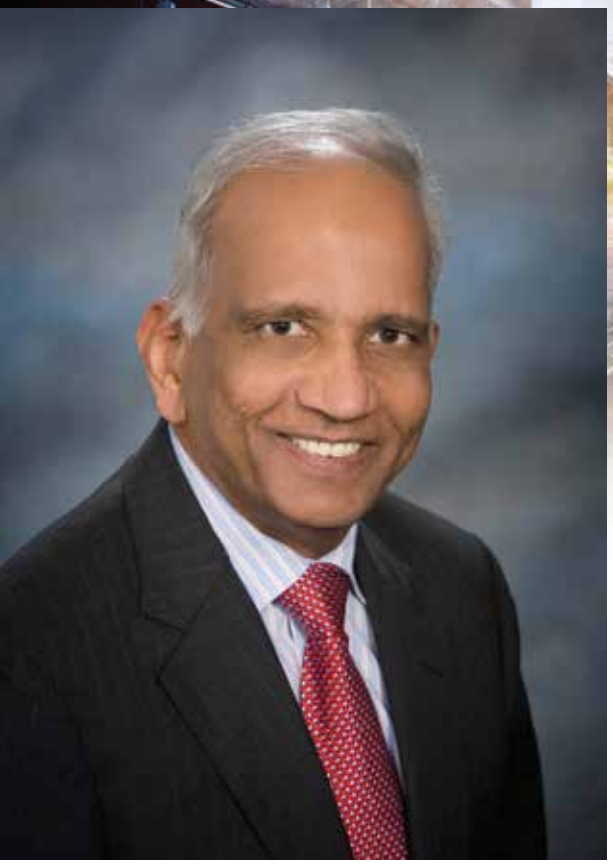
ABOUT MEDC

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

ABOUT THE SPE ACCE

Held annually in suburban Detroit, the SPE Automotive Composites Conference & Exhibition draws over 700 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 OEMs, and another 25% for tier suppliers. Attendees also represent composite materials, processing equipment, additives, and 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. This year's show will be held **September 9-11, 2014** at **The Diamond Banquet & Conference Center at the Suburban Collection Showplace**, 46100 Grand River Avenue, Novi, MI 48374. For more information about the SPE ACCE, see **http://speautomotive.com/comp.htm**, or **http://specomposites.com**.

Last year, three students won the ***SPE ACCE Scholarship Awards*** sponsored by **Michigan Economic Development Corp.** for the 2013-2014 academic year. Winning students whose composites-intensive projects were judged to have the greatest potential impact on ground transportation were **Thomas Keith (Keith) Honaker-Schroeder** of ***Michigan State University*** (left), **Nicholas (Nick) Smith** of ***Purdue University*** (middle), and **Sarah Stair** of ***Baylor University*** (right). Each student received a total scholarship of $2,000 USD — and will return to present the results of his or her research at this year's SPE ACCE show, September 9-11, 2014.



AUTOMOTIVE

Auto Plastics Expert, Norm Kakarala Named 2014 SPE® Automotive Div. Lifetime Achievement Award Winner

Dr. Norm Kakarala, who has had a notable 46-year career in automotive plastics at companies like General Motors Corp., Delphi Corp., Inteva Products LLC, and Uniroyal Tire Co., has been named the 2014 ***Lifetime Achievement Award*** winner by the SPE Automotive Division. He will be honored for his role leading automotive plastics and composites innovations at the 44th-annual ***Automotive Innovation Awards Gala*** on **November 12, 2014** at Burton Manor (**www.burtonmanor.net**) in Livonia, Michigan, USA. First given in the year 2000, the award recognizes the technical achievements of individuals whose work – in research, design, and/or engineering, etc. – has led to significant integration of polymeric materials on passenger vehicles.

Lifetime Acheivement

Dr. Norm Kakarala was selected as this year's Lifetime Achievement Award winner for his extensive work during a career spanning almost five decades as a technical specialist in the area of polymers, composites, and thermoplastic polyolefin (TPO) formulations, including adhesives, coatings, and rubber. He is well known for his work in understanding structure-property relations and the influence of forming processes like injection molding, sheet extrusion, and thermoforming on materials. He has a strong background as a technical liaison between product development and production implementation of automotive plastics. He also has designed accelerated laboratory tests to predict product-service performance of automotive plastic components, many of which have subsequently been adopted as industry standards.

Kakarala recently retired (2013) as senior technical fellow at Inteva Products LLC (Troy, Michigan) where he received awards for TPO formulations for interior skin applications for new General Motors programs, developed a soft, wrappable TPO skin/foam bilaminate for cut & sew interior trim applications, and also validated clearcoat systems for extruded-to-color TPO sheet for thermoforming applications. He joined the company in 2008 when Delphi Automotive Systems (Troy, Michigan) spun off its interiors business as Inteva.

Before that, Kakarala was a senior technical fellow from 1996 to 2008 at Delphi where he validated closed-loop recycling systems for interior TPO skins using sheet extrusion and thermoforming, developed in-house TPO formulations for sheet extrusion and thermoforming, and managed the company's interior materials and parts testing laboratory for quality and durability evaluations.

From 1981 to 1996, Kakarala was a staff development engineer at General Motors Corp. (GM) at the company's technical center in Warren, Michigan. While there, he worked with car groups in the selection of materials for new vehicle programs on notable cars like the *Chevrolet Camaro*, and plastic/composite-bodied vehicles like the *Chevrolet Corvette* and *Pontiac Fiero* sports cars and the *Chevrolet Lumina*, *Oldsmobile Silhouette*, and *Pontiac Trans Sport* minivans. He also developed industry standards on adhesives and composites through his work as GM's representative on the Automotive Composites Consortium of the United States Council for Automotive Research LLC (USCAR), the precompetitive research consortium for General Motors, Ford Motor Co., then Chrysler Corp. (now Fiat Chrysler Automobiles). Kakarala also managed a materials development and testing group at GM to support both vehicle and component development teams. When GM spun off its part-production operations as Delphi in 1996, Kakarala went with the business.

Lifetime Acheivement CONTINUED FROM PAGE 20

Before his work at GM, Kakarala was a staff research engineer at Uniroyal Tire Co. (Detroit, Michigan) from 1967-1981. During his years there, he formulated rubber compounds to meet exacting service requirements for steel-belted radial tires. He also was a project leader on the company's Canadian government contract for aircraft tires with all-synthetic materials. Kakarala also managed a materials testing laboratory at Uniroyal where he developed test procedures and standards for shear tear and fatigue properties of rubber-tire compounds.

Among Kakarala's significant career accomplishments, he received the Lifetime Achievement Award from the SPE Detroit Section (2011), he was inducted as a fellow in the Society of Plastics Engineers International (2004), he received SPE's Honored Service Member award (2003), he received the Engineering Society of Detroit's Gold Award for outstanding professional achievement (2002), and he received the 1999 Recycler of the Year award from the SPE Recycling Division (now SPE Environmental Division) for closed-loop recycling of TPO skins.

Additionally, Kakarala has organized numerous technical sessions and presented over 30 technical papers at conferences from SPE, the American Society for Testing & Materials (ASTM), and SAE International (previously called Society of Automotive Engineers). He also helped found the SPE Automotive Engineered Polyolefins Conference and has served as the event's technical program chair or co-chair for the event's entire 16 years, he has been a seminar leader for high-speed testing of plastics, and has published two lead chapters in the ASTM handbook on impact testing. He also holds eight U.S. patents for different TPO material formulations for vehicle interior skins and molded parts, and three TPO instrument-panel applications that he has worked on over the years have been winners in the Vehicle Interiors category of the SPE Automotive Innovation Awards Competition.

Kakarala has served as president of the SPE Detroit Section (1998-1999) and chair of the SPE Automotive Division (2004-2005), and he has developed ASTM and SAE standards for testing plastics and polymer composites during his years working for General Motors. Even in retirement, he continues to be active in organizing technical sessions for the SPE Automotive Engineering Plastics Conference (AutoEPCON), an event he founded, and the SPE Automotive Engineered Polyolefins Conference.

Kakarala holds a doctorate from University of Detroit, an M.S. degree from Wayne State University, and a B.S. degree from Andhra University — all in Chemical Engineering.

On **November 12**, Kakarala will be honored for his significant contributions to automotive composites and plastics innovations at this year's ***SPE Automotive Innovation Awards Gala*** starting with the VIP Cocktail Reception at 4:30 p.m., generously sponsored by Celanese Corp. At 5:00 p.m. the main exhibit area will open for general admission and guests can review this year's ***Automotive Innovation Awards*** part nominations, as well as enjoy the specialty and antique vehicles that are always a highlight of the show. Dinner will begin at 6:30 p.m. and the awards program itself will last from 7:00-9:00 p.m. For those who wish to extend merrymaking and networking activities, the ever-popular Afterglow – also sponsored by Celanese – will run from 9:00-11:00 p.m.

For more information, see **http://speautomotive.com/inno** and **http://speautomotive.com/awa.**

Past SPE Automotive Lifetime Achievement Award Winners include:

- J.T. Battenberg III, former chairman and chief-executive officer of Delphi Corp.;
- Bernard Robertson, then executive vice-president of DaimlerChrysler;
- Robert Schaad, chairman of Husky Injection Molding Systems, Ltd.;
- Tom Moore, retired vice-president, Liberty and Technical Affairs at then DaimlerChrysler;
- Mr. Shigeki Suzuki, general manager - Materials Division, Toyota Motor Co.;
- Barbara Sanders, retired director-Advanced Development & Engineering Processes, Delphi Corp.;
- Josh Madden, retired executive at General Motors Corp. (GM) & Volkswagen of America;
- Frank Macher, former CEO of Collins & Aikman Corp., Federal Mogul Corp., and ITT Automotive;
- Irv Poston, retired head of the Plastics (Composites) Development-Technical Center, GM.;
- Allan Murray, Ph.D., retired technology director at Ford Motor Co.;
- David (Dave) B. Reed P.E., retired staff engineer, Product Engineering, GM;
- Gary Lownsdale, P.E., chief technology officer, Plasan Carbon Composites; and
- Roy Sjöberg, P.E., retired, General Motors Corp. & Chrysler Corp.

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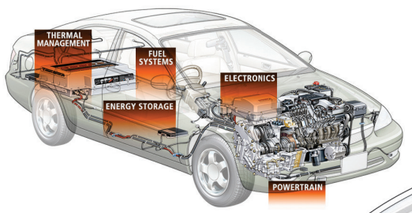

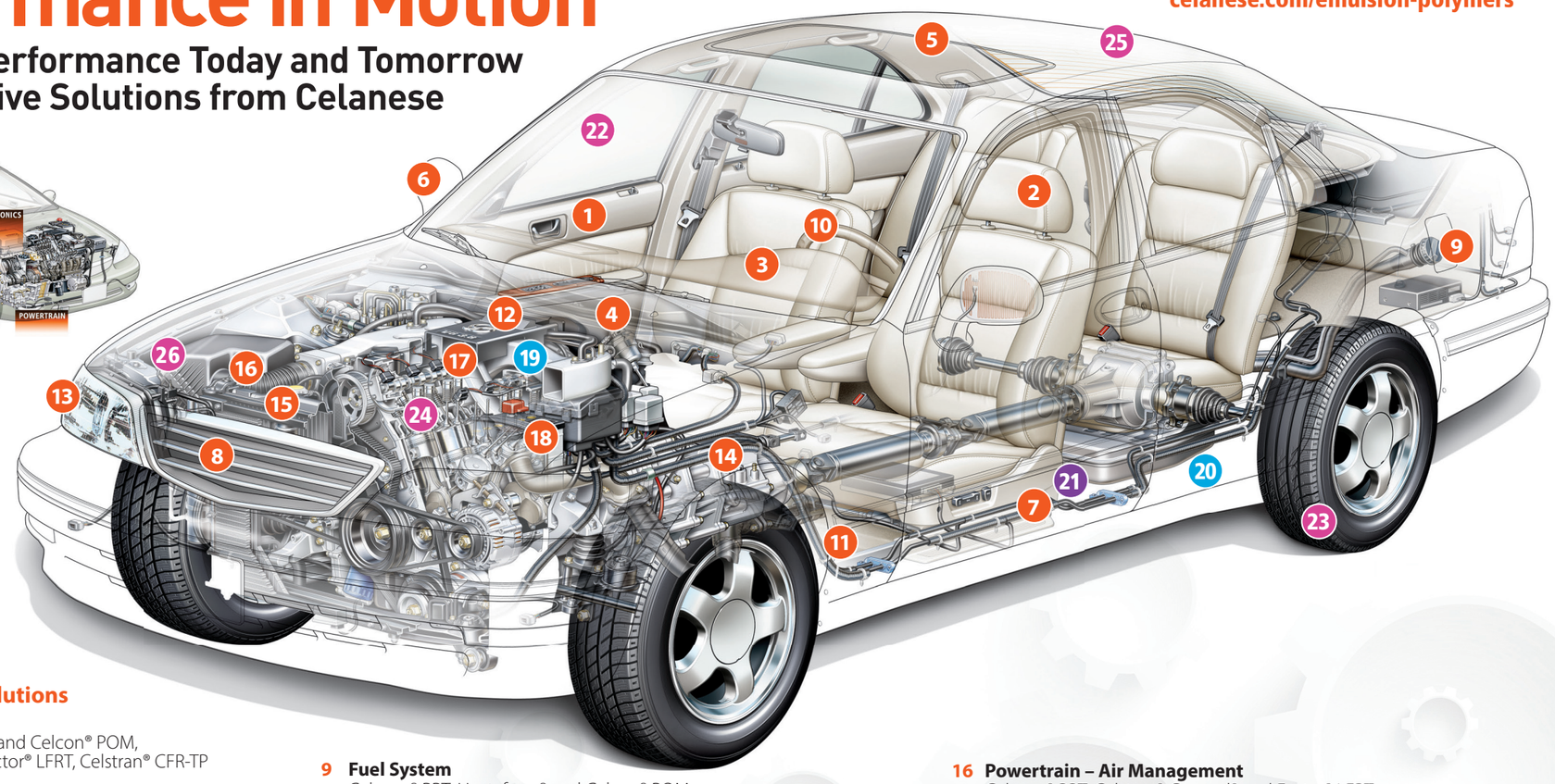

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SPE Automotive councilor, Tom Pickett accepts the division's Pinnacle Gold award from 2013-2014 SPE President, Jon Ratzlaff at an awards event during SPE's Annual Technical Conference (ANTEC) in Las Vegas, Nevada, USA. The gold level of the Pinnacle Award is the highest any SPE division or section can achieve and honors successful efforts to create and deliver member value during the year.

COUNCILOR'S REPORT

April 27, 2014 - Council I & II Meeting Minutes

Las Vegas, Nevada, USA

by Tom Pickett, SPE Automotive Div. Councilor

COUNCILOR I MEETING

1. WELCOME, ANTI-TRUST & CONFLICT OF INTEREST

2013-2014 SPE President Jon Ratzlaff called the meeting to order at 8:30 a.m. Pacific time, and reminded everyone that the meeting was operating under SPE's Antitrust and Conflict of Interest policies.

2. ROLL CALL

Determination of Attendance

Secretary Jeffrey Helms conducted a formal roll call. Proxies were identified. Secretary Helms made a motion to seat the proxies. The motion was seconded and passed.

President Ratzlaff recognized the current year Executive Committee (EC), the SPE staff, and past presidents in attendance.

Secretary Helms 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 Helms asked if there were any questions on the 2013 EC meeting minutes from November 13-14, 2013, December 19, 2013, January 30, 2014, and March 3, 2014. There were none. Secretary Helms asked if there were any questions on the November 16, 2013 council meeting minutes. There were none.

Secretary Helms requested a motion to approve the EC meeting minutes from November, December, January, March, and the council meeting minutes from November 16, 2013 as presented. A motion was provided, seconded, and passed.

5. OPENING REMARKS

President Ratzlaff remarked on the SPE accomplishments in 2013. SPE had four global conferences last year Other notable accomplishments include the use of "apps" for conferences, the new SPE logo and website, and a new user-friendly membership system. SPE International offered expanded services for TOPCONs. There is a global parts competition that will take place at ANTEC. Ratzlaff thanked the volunteers, EC, staff and SPE CEO, Wim De Vos.

6. FINANCIAL

Dick Cameron reported Q1 2014 had a positive income of $358,000 USD. It is $100,000 above the budget due to receiving more money ahead of time for the ANTEC conference. However, when expenses for ANTEC come in, it is expected to bring us back to budget. SPE has a new auditor. The auditor concluded that SPE is in good financial standing. Cameron recognized his fellow finance committee members.

7. INFORMATION TECHNOLOGY COMMITTEE (ITC)

Tom Conklin remarked that the new SPE website is designed for easy navigation. The new site has daily updates. The home page is the most visited on the site, followed by the events page. The events page has advertisement for sale. SPE already sold $45,000 in advertisement. The new web site cost $125,000. SPE encourages each division and section to put their information from their independent website onto the SPE website so there is one uniform SPE website. If a division or section does not have enough resources to transfer information onto the new SPE site, then let Tom Conklin know and Conklin will have his SPE staff help for a cost of approximately $3,500 to $12,000 depending on the amount of time to transfer information. It was reported that the Akron Section had tech-savvy students who had received a scholarship to migrate the information from the Akron website to the new SPE website. It was suggested that other divisions and sections also might want to have students or a volunteer help with the transfer. It is recommended that groups only migrate information that is needed. At the time, Tom Conklin did not know if there will be an annual maintenance fee for each division or section to use the new SPE website.

Wim De Vos discussed event apps. It is recommended that planning committees use the SPE event app for their conferences. There is no charge to use apps for conferences. SPE plans to make more short videos that will market the society. De Vos believes videos are attractive to the next generation and young professionals. Videos cost $2,000 to $3,000. De Vos played a video that was made to advertise ANTEC.

Scott Owens presented information on The Chain. The Chain is an SPE virtual community. It is web-based networking that acts as a bridge to share information between meetings. Owens is working with Higher Logic to create The Chain. The phase 1 soft launch will be September 2014. The full launch is expected by November 2014.

8. MEMBERSHIP

Tom Conklin reported a decline in membership. In 2013, SPE had 14,025 members. In 2014, SPE has 13,642 members. There is a change in strategy for getting members. There will be less reliance on direct-mail campaigns and more focus on providing value to members. There will be use of the internet, the new SPE website, conference apps, the SPE social network, the upgraded online library, and new global conferences. There is an online join and renew membership process. The membership chairs for each division and section need to make sure the new system is working and that the names from the old system got transferred over to the new membership system. Tom Conklin requested that membership chairs let him know about any issues that are discovered with the new membership system.

 CONTINUED FROM PAGE 26

9. COMMITTEE REPORTS

Sections Committee:

Monica Verheij moved that council approve that 88 schools and sections be deleted for being inactive.

Division Committee:

Brian Landers reported the divisions plan to focus on four areas 1) TOPCONs, 2) Educational Training, 3) Membership / Value, and 4) Organizational / Structure. Austin Coffey is elected vice chair of the Division Committee.

Next Generation Committee:

J. Gomez presented the activities of the Next Generation Committee. There is a race planned at ANTEC.

Student Activities Committee:

At ANTEC there is the student poster session and judging, three student podium sessions, a student plant tour of Berry Plastics, and a student awards luncheon. The Student Activities Committee received funding from different divisions and sections. The Automotive Division was recognized as a Bronze Sponsor.

Council Committee of the Whole (CCOW):

Sandra McClelland reported on the Council Committee of the Whole (CCOW), which will look to combine the section and division meetings with CCOW. Tom Pickett voiced Monica Prokopyshen and other Automotive board members' concern regarding personal liability of division officers and directors for risk / losses of SPE Automotive events. Wim De Vos responded that Automotive Division officers and directors are insured under the SPE International insurance for TOPCONs and SPE activities that are reported to SPE International. This includes coverage of the division's officers and chairs for the SPE Automotive Innovations Awards Competition & Gala.

10. BYLAWS & POLICIES UPDATE

Len Czuba discussed the importance for bylaws to provide rules and noted that they also are required to maintain non-profit status. Highlights of some of the changes in the Bylaws & Policies were presented.

11. AWARDS LUNCHEON

The Automotive Division received the SPE Pinnacle Gold Award. This is the highest award that SPE bestows on a division. In addition, the Automotive Division received the 2014 Communications Excellence Award. It is the highest award that SPE gives to a division or section that has demonstrated outstanding communications. Congratulations to Yvonne Merritt, chair of the Automotive Division, for her great leadership that enabled our group to achieve these awards. Also a big thank you to Peggy Malnati and her newsletter team for their great work with the newsletter. Furthermore a thank you to each SPE Automotive Division board member, the committee chairs, and the many volunteers for all their great work and support in helping us have a great year.

COUNCILOR II MEETING

1. ROLL CALL

Determination of Attendance

Secretary J. Gomez made a motion to seat the proxies. The motion was seconded and passed.

2. APPROVAL OF THE AGENDA

It was moved, seconded, and passed that the agenda, as published, be approved.

3. OPENING REMARKS

Incoming 2014-2015 SPE President, Vijay Boolani remarked that in today's world, SPE needs to make decisions at lightning speed. Boolani added that this means SPE needs to accelerate bylaw change. In addition, he noted that SPE needs to offer value to members. Moreover, SPE needs to meet the generation changes. Furthermore, SPE must adapt to global geographical changes.

4. APPROVAL OF APPOINTED MEMBERS TO THE EXECUTIVE COMMITTEE

Most of the EC are returning from the past year. Boolani appointed two new members to the EC. The appointments were approved.

5. APPROVAL OF OPERATING PLAN

Boolani received approval of the 2014-2015 society operating plan. Motion to hold the 2017 annual business meeting in Anaheim, California, USA was approved.

6. SPE STRATEGIC PLAN FOR 2014-2016

Wim De Vos discussed the SPE vision. Individuals worldwide should think of SPE as the source of information on plastics. SPE must offer a reliable source of information on plastics. There is a need to bring higher value to more members. De Vos discussed the market realities from the book Race for Relevance. SPE needs to change. De Vos believes SPE needs to attract younger members. Also SPE needs to create more global activities and should have a professional information technology (IT) team. It should have staff around the world that services our conferences. In addition, SPE should have a sales team that goes out to the market and promotes SPE and its products worldwide. De Vos discussed the future role of council. De Vos discussed the radical changes from Race for Relevance and how it relates to SPE. In conclusion, he stressed the need to rejuvenate SPE's brand image to attract younger members and the need to evolve to a more centralized structure.

7. OTHER OLD / NEW BUSINESS

De Vos discussed the expense for remote participation of CCOW and questioned if we need remote participation for Council when there are no elections.

8. ADJOURNMENT

Boolani requested a motion to adjourn the meeting. A motion was made, seconded, and passed. The meeting adjourned. Next Council Meeting is September 13-14 in New Orleans, Louisiana, USA.

Three-Dimensional Prediction of Fiber Orientation for Injection Molding of Long Fiber Reinforced Thermoplastics

Huan-Chang Tseng, Yuan-Jung Chang, Tzu-Chang Wang, Chia-Hsiang Hsu
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ABSTRACT

Long fiber-reinforced thermoplastic composites have more critical requirements in automotive industry than short FRTS. FRT products' mechanical properties and warpage are highly dependent upon fiber orientation within the part. We recently proposed a new fiber orientation model for improving the prior developed models regarding interaction and diffusion of the fibers immersed in a matrix, namely, iARD-RPR (Improved Anisotropic Rotary Diffusion model combined with Retarding Principal Rate model) [U.S. Patent Pending in USPTO with Application No. US-2012-0330627-A1 (2012)]. The iARD-RPR model has been demonstrated to describe changes in fiber orientations, whether treating short fibers or long fibers. In this study, we performed injection molding of a center gated disk for the 40wt%glass-fiber immersed in polypropylene matrix, and then predicted the fiber orientation distribution. As a result, the shell-core structure of the orientation assessments at three regions of the near-entry, the lubrication, and the near-end-of-filling were in good agreement with experimental observations.

INTRODUCTION

To date, short/long fiber-reinforced thermoplastic (FRT) composites can improve their specific mechanical properties, including their tensile property, thermal expansion, electrical conductivity, and water penetrability. Long fibers are generally longer than 1 mm. long FRTs essentially yield continuous-fiber reinforcement, but not short FRTs. Thus, the former is superior to the latter. Those mechanical properties of FRT products are strongly dependent on fiber orientation [1].

However, rheological behavior regarding the plurality of fibers immersed in polymeric matrix flowing through a filling mold of injection process is very complex. Therefore, the mathematical model for describing orientation states of fibers is of importance. The fact that the fiber orientation distribution further controls anisotropic shrinkage/warpage of FRT parts is considerably obvious. It is a significant concern in Figure 1 that the most noticeable feature of the filling is the existence of a shell/core fiber orientation structure across the thickness of the molded part: those fibers found in the shell region (near the cavity wall) are strongly aligned in the flow direction, but others in the core region (near the cavity center) are transverse to the flow.

Dr. Ivor Huan-Chang Tseng, program manager at ***CoreTech System (Moldex3D) Co. Ltd.***, was named a Best Paper Award winner by the peer-review committee for the 2013 **SPE® Automotive Composites Conference & Exhibition** (ACCE). Tseng was lead author (along with Yuan-Jung Chang, Tzu-Chang Wang, and Chia-Hsiang Hsu of CoreTech System (Moldex3D) Co., Ltd. and Rong-Yeu Chang, National Tsing-Hua University) on a paper entitled *Three Dimensional Predictions of Fiber Orientation for Injection Molding of Long Fiber Reinforced Thermoplastics*, which was presented on September 11, 2013 by Moldex3D colleague, Ken (KC) Cheng. Cheng accepted a special plaque on behalf of Teng for excellence in technical writing during opening ceremonies at the thirteenth-annual SPE ACCE on September 11 last year.

Tseng received his Ph.D. degree in Applied Chemistry from National Chiao-Tung University (NCTU) in Taiwan in 2008. Under the direction of professors Rong-Yeu Chang and Jiann-Shing Wu, Tseng's major research interests focused on molecular simulations, involving Molecular Dynamics (MD), Monte Carlo (MC), and Dissipative Particle Dynamics (DPD) methods, with applications to predictions of nano-thermodynamic and nano-rheological properties of polymer materials. Many of his non-equilibrium molecular dynamics simulation (NEMD) studies for sheared n-hexadecane fluid have been published in the *Journal of Chemical Physics*. In his current job as program manager in the R&D Division of CoreTech System Co., Ltd., Tseng's main research areas are composite and polymer processing, polymer rheology and viscoelasticity, and molecular simulations, and he is responsible for theoretical development with a focus on the prediction of fiber orientation during processing of fiber-reinforced composites. Recently, he has expanded his research into new areas including powder concentration and particle migration for metal injection molding (MIM).

To design products effectively, anticipation of the orientation distribution is necessary. The primary objective of this study was to obtain good predictions of shell-core structure orientation distribution for long fibers in the filling flow of injection molding process, As compared with related experimental measures, wherein the molding geometry is a center gated disk, the polymer matrix is polypropylene, and the fiber concentration is 40wt%. These predictions were performed by a 3D injection molding simulation technique employing recent fiber orientation models.

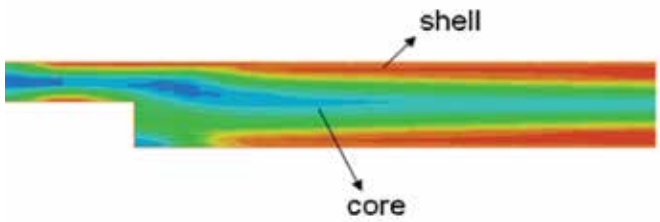

Figure 1 the shell-core structure of fiber orientation distribution in mold filling.

THEORY OF FLUID MECHANICS

Polymeric fluids are generally assumed as Generalized Newtonian Fluid (GNF). The governing equations to describe the transient and non-isothermal flow motion for center gated disk are shown, as follows:

$$\frac{\partial \rho}{\partial t} + \nabla \cdot \rho \mathbf{u} = 0 \quad (1)$$

$$\frac{\partial}{\partial t}(\rho \mathbf{u}) + \nabla \cdot (\rho \mathbf{u}\mathbf{u} - \boldsymbol{\sigma}) = \rho \mathbf{g} \quad (2)$$

$$\boldsymbol{\sigma} = -P\mathbf{I} + \eta(\nabla \mathbf{u} + \nabla \mathbf{u}^{\mathrm{T}}) \quad (3)$$

$$\rho C_p \left(\frac{\partial T}{\partial t} + \mathbf{u} \cdot \nabla T \right) = \nabla \cdot (k \nabla T) + \eta \dot{\gamma}^2 \quad (4)$$

where ρ is density; $\mathbf{u}$ is velocity vector; t is time; $\boldsymbol{\sigma}$ is total stress tensor; $\mathbf{u}$ is acceleration vector of gravity; P is pressure; η is viscosity; C_p is specific heat; T is temperature; k is thermal conductivity; γ is shear rate; the superscript T is the transpose operator of a matrix. Finite Volume method (FVM) is employed due to its robustness and efficiency to solve the transient flow field in a three-dimensional geometry with complex.

PRIOR FIBER ORIENTATION MODELS

A *single* fiber is regarded as an axisymmetric bond with rigidness. The bond's unit vector $\mathbf{p}$ along its axis direction can describe fiber orientation. The orientation state of a *group* of fibers [1-4] is given by the second moment tensor,

$$\mathbf{A} = \oint \psi(\mathbf{p})\mathbf{p}\mathbf{p}d\mathbf{p}, \quad (5)$$

where $\psi(\mathbf{p})$ is the probability density distribution function over orientation space.

For the sake of completeness, one introduces a brief survey of the fiber suspension in the rheological area, including two representative theoretical models over the past three decades: (i) Jeffery's Hydrodynamic (HD) model [5] and (ii) Folgar and Tucker's Isotropic Rotary Diffusion (IRD) model [6]. In general, the hydrodynamic model combined with the IRD model is called the standard Folgar-Tucker (FT) orientation Equation, which is expressed in the second order orientation tensor:

$$\mathbf{A} = \oint \psi(\mathbf{p})\mathbf{pp}d\mathbf{p}\,, \qquad \mathbf{A}^{\mathrm{HD}} + \mathbf{A}^{\mathrm{IRD}} \tag{6}$$

$$\mathbf{A}^{\mathrm{HD}} = (\mathbf{W}\cdot\mathbf{A} - \mathbf{A}\cdot\mathbf{W}) + \xi(\mathbf{D}\cdot\mathbf{A} + \mathbf{A}\cdot\mathbf{D} - 2\mathbf{A}_4 : \mathbf{D}) \tag{7}$$

$$\mathbf{A}^{\mathrm{IRD}} = 2\gamma C_I(\mathbf{I} - 3\mathbf{A}) \tag{8}$$

where $\mathbf{A}$ represents the material derivative of the tensor $\mathbf{A}$; $\mathbf{I}$ is the identity matrix; C_I is the fiber-fiber interaction parameter; ξ is a shape factor of a fiber.

$$\mathbf{L} = \nabla\mathbf{v} = \mathbf{W} + \mathbf{D} \tag{9}$$

is the velocity gradient tensor with its component of

$$L_{ij} = \nabla_j v_i \tag{10}$$

where v_i is the component of the velocity in the x_i direction.

$$\mathbf{W} = \frac{1}{2}(\mathbf{L} - \mathbf{L}^{\mathrm{T}}) \tag{11}$$

is the vorticity tensor.

$$\mathbf{D} = \frac{1}{2}(\mathbf{L} + \mathbf{L}^{\mathrm{T}}) \tag{12}$$

is the rate-of-deformation tensor.

$\mathbf{A}_4$ is a fourth order orientation tensor, defined as:

$$\mathbf{A}_4 = \oint \psi(\mathbf{p})\mathbf{pppp}d\mathbf{p} \tag{13}$$

where this tensor is also symmetric. The acceptable calculation of such a particular tensor is obtained through the eigenvalue-based optimal fitting approximation of the orthotropic closure family developed by Tucker and colleagues [7-8]. In fact, the FT orientation equation has always predicted an initial quicker rate of orientation kinetics at a transient state, as compared to related experiments [1, 9].

Recently, Phelps and Tucker proposed the Anisotropic Rotary Diffusion (ARD) model [4] for long fiber suspension. More importantly, Wang *et al.* developed the Reduced Strain Closure (RSC) model [1] to resolve the quicker response problem of orientation in prediction for short fibers. Therefore, the ARD-RSC model [4] can be further derived , as follows:

$$\begin{aligned}\mathbf{A} &= \mathbf{W}\cdot\mathbf{A} - \mathbf{A}\cdot\mathbf{W} \\ &+ \xi\{\mathbf{D}\cdot\mathbf{A} + \mathbf{A}\cdot\mathbf{D} - 2[\mathbf{A}_4 + (1-\kappa)(\mathbf{L}_4 - \mathbf{M}_4 : \mathbf{A}_4)] : \mathbf{D}\} \\ &+ \gamma\left\{\begin{matrix} 2[\mathbf{D}_r - (1-\kappa)\mathbf{M}_4 : \mathbf{D}_r] - 2\kappa\mathrm{Tr}(\mathbf{D}_r)\mathbf{A} - 5(\mathbf{D}_r\cdot\mathbf{A} + \mathbf{A}\cdot\mathbf{D}_r) \\ + 10[\mathbf{A}_4 + (1-\kappa)(\mathbf{L}_4 - \mathbf{M}_4 : \mathbf{A}_4)] : \mathbf{D}_r \end{matrix}\right\}\end{aligned} \tag{14}$$

$$\mathbf{L}_4 = \sum_{i=1}^{3} \lambda_i \mathbf{e}_i\mathbf{e}_i\mathbf{e}_i\mathbf{e}_i \tag{15}$$

$$\mathbf{M}_4 = \sum_{i=1}^{3} \mathbf{e}_i\mathbf{e}_i\mathbf{e}_i\mathbf{e}_i \tag{16}$$

where the parameter κ is fit by experimental data; eigenvalues; the fourth order tensors $\mathbf{L}_4$ and $\mathbf{M}_4$ are calculated from the eigenvalues and the eigenvectors; $\mathbf{Tr}(\mathbf{D}_r)$ is the trace operator of matrix $\mathbf{D}_r$. A detailed derivation of the RSC model is available elsewhere [1, 10].

The diffusion tensor $\mathbf{D}_r$ [4] is suggested to approach the Hand tensor [11], which depends on orientation tensor $\mathbf{A}$ and rate-of-deformation tensor $\mathbf{D}$:

$$\mathbf{D}_r = b_1\mathbf{I} + b_2\mathbf{A} + b_3\mathbf{A}^2 + \frac{b_4}{\gamma}\mathbf{D} + \frac{b_5}{\gamma^2}\mathbf{D}^2 \tag{17}$$

where the values of $b_1, b_2, b_3, b_4,$ and b_5 are the parameters fit by experimental data.

A NEW FIBER ORIENTATION MODEL

Recently, Tseng et al. developed a new three-parameter fiber orientation model with physical meaning, namely, the iARD-RPR model (known as Improved Anisotropic Rotary Diffusion model combined with Retarding Principal Rate model) which is suitable for both short and long fibers filled materials.

$$\mathbf{A} = \mathbf{A}^{\mathrm{HD}} + \mathbf{A}^{\mathrm{iARD}} + \mathbf{A}^{\mathrm{RPR}} \tag{18}$$

where two dimensionless parameters C_I and C_M describe the fiber-fiber interaction and fiber-matrix interaction, respectively while parameter κ can slow down a response of fiber orientation.

The improved ARD model (abbreviated as the iARD model), $\mathbf{A}^{\mathrm{iARD}}$, involves the IRD term mentioned above [see Eq. (8)], ^{IRD}, with a new anisotropic term of the steric barrier (SB), ^{SB}:

$$^{\mathrm{iARD}} = {}^{\mathrm{IRD}} + {}^{\mathrm{SB}} \tag{19}$$

$$\mathbf{A}^{\mathrm{SB}} = 2\gamma C_I C_M \left\{ \begin{array}{l} (\mathbf{A} - \tilde{\mathbf{L}}) + 5[(\mathbf{A}\cdot\tilde{\mathbf{L}})_{\mathrm{symm}} \\ -(\mathbf{A}_4 : \tilde{\mathbf{L}})] \end{array} \right\} \tag{20}$$

$$\tilde{\mathbf{L}} = \frac{\mathbf{L}^{\mathrm{T}}\cdot\mathbf{L}}{\mathbf{L}^{\mathrm{T}} : \mathbf{L}} \tag{21}$$

$$(\mathbf{A}\cdot\tilde{\mathbf{L}})_{\mathrm{symm}} = \frac{1}{2}[\mathbf{A}\cdot\tilde{\mathbf{L}} + (\mathbf{A}\cdot\tilde{\mathbf{L}})^{\mathrm{T}}] \tag{22}$$

where the tensor $\tilde{\mathbf{L}}$ is a so-called dimensionless flow-resistance tensor, depending on the tensor $\mathbf{L}$; $(\mathbf{A}\cdot\tilde{\mathbf{L}})_{\mathrm{symm}}$ is the symmetric matrix of $\mathbf{A}\cdot\tilde{\mathbf{L}}$; $(\mathbf{A}\cdot\tilde{\mathbf{L}})^{\mathrm{T}}$ is transpose of $\mathbf{A}\cdot\tilde{\mathbf{L}}$.

Since the fiber-matrix interaction is considered to slow down both the fiber hydrodynamics and diffusion of the intrinsic orientation kinetic (IOK) mechanism, the RPR orientation tensor rate, $\mathbf{A}^{\mathrm{RPR}}$, is mathematically described using the similarity transformation of linear algebra, below,

$$= \quad \cdot \mathbf{\Lambda} \cdot \quad ^{\mathrm{T}} \tag{23}$$

$$\mathbf{A}^{\mathrm{RPR}} = -\mathbf{R}\cdot\mathbf{\Lambda}^{\mathrm{IOK}}\cdot\mathbf{R}^{\mathrm{T}} \tag{24}$$

where the rotation matrix, $\mathbf{R}$, with its transpose of matrix, $\mathbf{R}^{\mathrm{T}}$, is defined by orientation tensor's three eigenvector columns, i.e., $\mathbf{R} = [\mathbf{e}_1, \mathbf{e}_2, \mathbf{e}_3]$; the diagonal matrix, $\mathbf{\Lambda}$, is given by the orientation tensor's three eigenvalues, $\Lambda_{ii} = \lambda_i$, $i = 1, 2, 3$, . Note that $\mathbf{R}$ is an orthogonal matrix, $\mathbf{R}\cdot\mathbf{R}^{\mathrm{T}} = \mathbf{R}^{\mathrm{T}}\cdot\mathbf{R} = \mathbf{I}$.

Significantly, a particular tensor, Λ^{IOK}, is known as the IOK diagonal tensor rate, and its component form may modeled by

$$\Lambda_{ii}^{IOK} = \alpha\left[\lambda_i - \beta\left(\lambda_i^2 + 2\lambda_j\lambda_k\right)\right] \quad i,j,k = 1,2,3 \qquad (25)$$

where α is in units of dimensionless and β is a time-constant; three eigenvalues, λ_1, λ_2, and λ_3, have a limitation of $\lambda_1 \geq \lambda_2 \geq \lambda_3$; λ_1, λ_2, and λ_3 are eigenvalues rates with respect to time; three subscripts, ***i, j,*** and ***k,*** are indexes of permutation. Full details of the RPR model and the iARD model mentioned above are available elsewhere [12].

RESULTS AND DISCUSSION

One case study that is a center-gated disk mold filling is shown in Figure 2, wherein ***r*** describes the flow or radial direction, θ is the cross-flow or tangential direction, and ***z*** is the thickness direction.

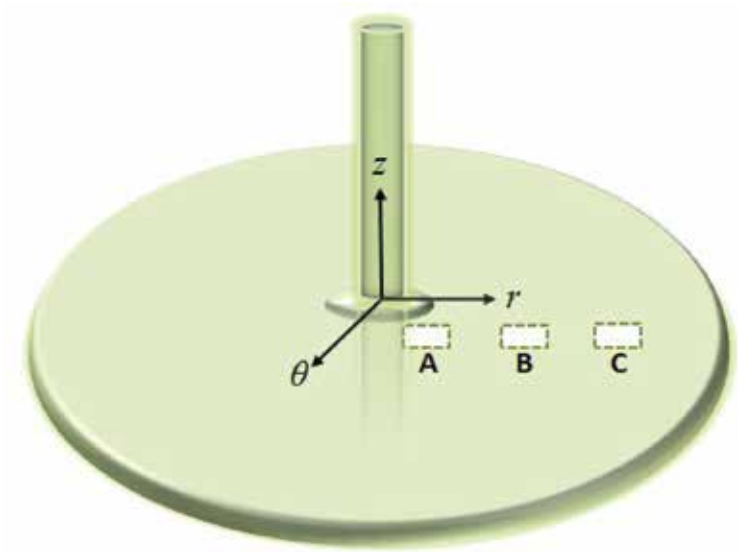

Figure 2 Geometry of center-gated disk of mold filling.
Three orientation components of A_{11}, A_{22}, and A_{33} are measured in three regions of A, B, and C.

The important orientation descriptors are the orientation tensor components: A_{11}, A_{22}, and A_{33} correspond to the flow, the cross-flow, and the thickness directions, respectively. In general, a high value of A_{11} would indicate a great deal of fibers lied in the flow direction, whereas a near-zero value of A_{33} would indicate little or no orientation in the thickness direction. These fiber orientation data through the thickness is measured at three regions of the near-entry, the lubrication, and the near-end-of-filling along the radial direction of the disk, marked as Regions A, B, and C, respectively.

Below one can investigate a comparison of the predicted and measured orientation tensor components, for dealing with long fibers flowing in a mold filling process of the disk. Those experimental data of fiber orientation were carried out by PNNL and ORNL using the Leeds image analysis system developed by Hine *et al.* [12]. Details of the sample preparation and measurement can be referred to in the published articles of O'Gara et al. [13] and Nguyen *et al.* [14].

A benchmark test of long fibers flowing during mold filling is originated from PNNL and ORNL. The density of glass-fiber/polypropylene (PP) material was reported as 1.22 g/cm^3 with a fiber weight fraction of 40%. The material is called MTI-PP40G, provided by Montsinger Technologies, Inc. The averaged glass fiber diameter is about 17.4 . The number average

fiber length is about 13 mm. The post-extruded average fiber length is about 2.87 mm. Such a longer length than 1 mm is generally considered as long fibers. The mold temperature was held to approximately 70°C, while the inlet temperature was 238°C. Note that the disk is 177.8 mm in diameter with a thickness of $2h$ = 3 mm. The Regions A, B, and C are located at 6 mm, 34 mm, and 64 mm in the radial direction, respectively. A volume flow rate is 118.32cm^3/sec with a filling time of 0.65 sec. The useful material properties, including rheological and thermal properties, are available elsewhere [15].

Here, the iARD-RPR model combined with Jeffery's Hydrodynamic model [16] was applied to simulate fibers flowing in the injection modeling process via a commercial CAE analysis program, Moldex3D R12 (copyrighted by CoreTech System). Recently, the ARD-RSC model also was developed by Tucker and coworkers [4, 17] to study long fiber suspension rheology for injection molding. Therefore, the objective of this study was to obtain the fiber orientation distribution, through the thickness, as compared with related experimental data.

Figures 3-5 show the prediction of orientation distributions through the normalized thickness obtained from three regions A, B, and C marked in the disk, respectively. The dashed line and solid line plotted in the figures indicates the ARD-RSC model and the iARD-RPR model, respectively, wherein original date of this ARD-RSC curve is caught from the PNNL report [14]. The iARD-RPR parameters are set: C_r = 0.005, C_M = 0.999, α = 0.1, and β = 0.01. Clearly, all of the distributions present the shell-core structure. As comparrd with the experimental result, A_{11} and A_{33} component was over-predicted by the ARD-RSC model, whereas the A_{22} component was under-predicted. Overall, the predictions by the iARD-RPR model were close to the experiments. In short, iARD-RPR model is reasonable and superior to the ARD-RSC model.

Referring to the PNNL report [14] by Nguyen *et al.*, the ARD-RSC orientation model was used to discuss assessments of fiber orientation for two different mesh models: midplane (2.5D or shell) and true 3D-solid. They reported that the midplane model properly calculates the variations in fiber orientation, but not the 3D orientation computation. This deviation of the prediction was attributed to the 3D calculation accuracy of the velocity gradient tensor. In addition, they suggested that the inlet condition is used to improve this assessment.

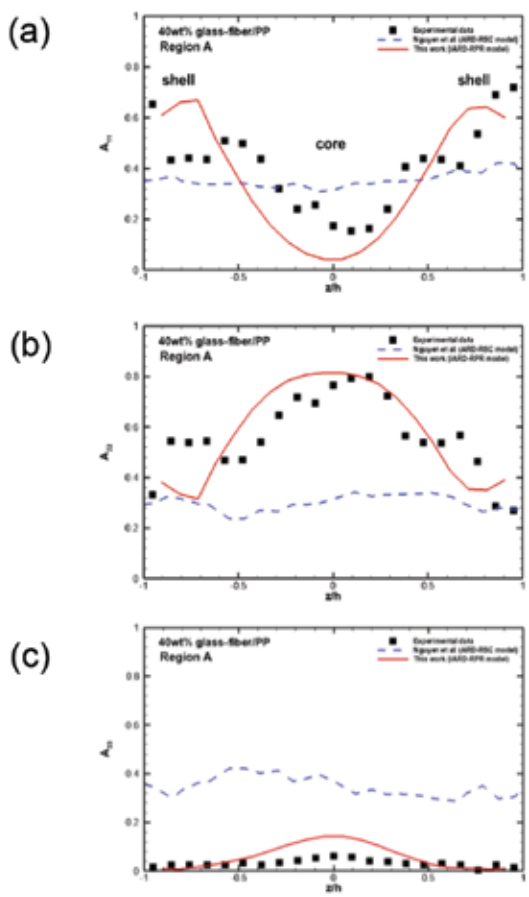

Figure 3 Comparison of the experimental and predicted data of three orientation components, (a) A_{11}, (b) A_{22}, and (c) A_{33}, through the normalized thickness and z/h at Regions A of the center-gated disk for the PP matrix blended with 40wt% long glass fibers.

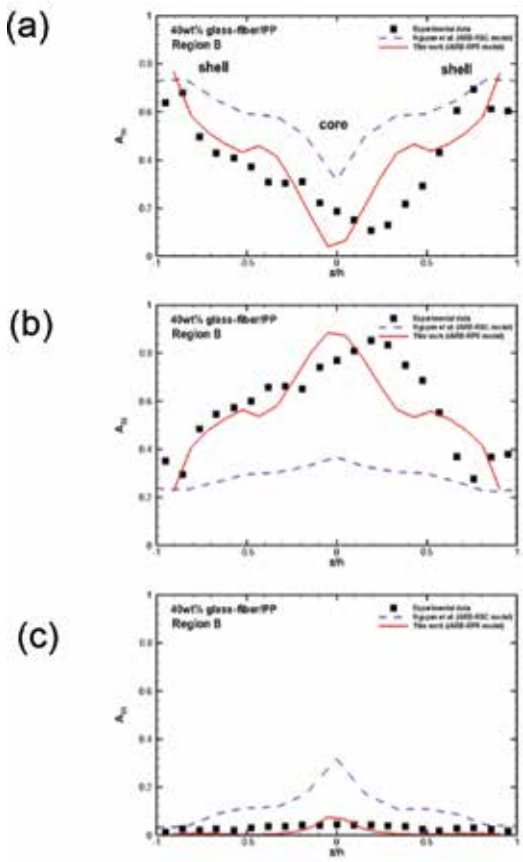

Figure 4 Comparison of the experimental and predicted data of three orientation components, (a) A_{11} , (b) A_{22} , and (c) A_{33} , through the normalized thickness z/h at Regions B of the center-gated disk for the PP matrix blended with 40wt% long glass fibers.

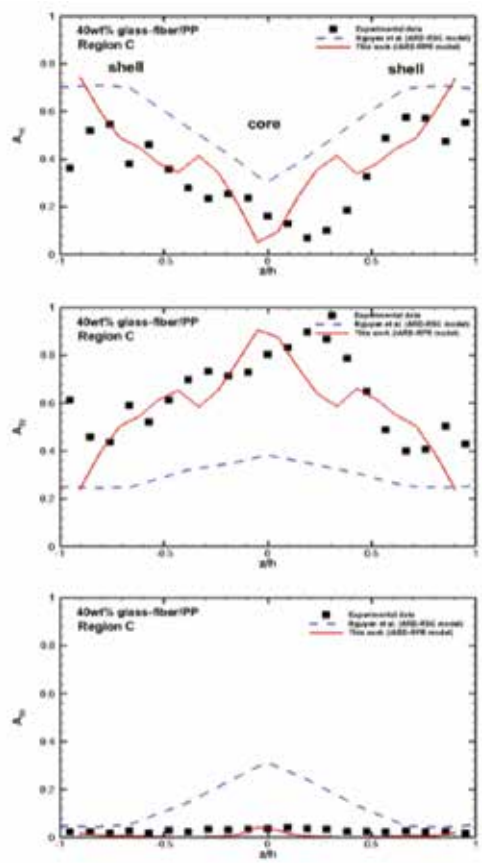

Figure 5 Comparison of the experimental and predicted data of three orientation components, (a) A_{11} , (b) A_{22} , and (c) A_{33} ,through the normalized thickness z/h at Regions C of the center-gated disk for the PP matrix blended with 40wt% long glass fibers.

 CONTINUED FROM PAGE 34

CONCLUSION

The iARD-RPR model for short/long reinforced thermoplastic materials, therefore, can provide good orientation predictions during mold filling, as compared with related experimental measurements. In future, this work will further use the iARD-RPR model to investigate that fiber orientation in filling process simulations of injection molding may be strongly affected by these factors of interest, for example: filling speed, mold temperature, molding geometry, molding thickness, matrix species and etc. Thus, these issues are important rheological studies.

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SECRETARY'S REPORT

SPE Automotive Division Board
Feb 10, 2014 Minutes

Next BOD Meeting: Monday, April 14, 2014

ATTENDEES

Yvonne Merritt
Peter Bejin
Teri Chouinard
Anthony Gasbarro
Vince Holmes
Edward Luibrand
Peggy Malnati
Mike Masserant
Tom Pickett
Rose Petrella
Ron Price
Dave Reed
Nippani Rao
Suresh Shah
Elias Shakour
Dawn Stephens
Steve VanLoozen
Mike Whitens

Meeting was held at ACC in Troy, 5:30 p.m. – 8:00 p.m.
December minutes were approved via email.

SOCIAL – Teri Chouinard

45 people are registered for the Feb. 11 plant tour at Asahi Kasei including 9 students from Ferris State as well as students from Michigan State, Kettering and Western Michigan Universities.

MEMBERSHIP – Steve VanLoozen

The proposal to provide 50 OEM memberships at a cost of $5,000 USD / yr was carried unanimously. The subcommittee proposed targeting OEM engineers who would then nominate other engineers in their organizations for membership. To qualify, an engineer must attend at least one local Detroit-area conference. In addition, for each OEM that participates, an engineering manager must submit an OEM perspective newsletter article for the *OEM's Corner*. Next steps: Steve and Dave to speak with OEMs with initial discussions focusing on 10 memberships / OEM. Peter Bejin volunteered to write the first *OEM's Corner* article.

Mike Whitens suggested an SPE hotline, *Phone an SPE Friend*, for new engineers with plastics/composites-related questions. Mike Whitens & Mike Masserant will pilot the concept internally at Ford. Access to the helpline service would be limited to SPE members. One suggestion was to staff the service with OEM or material supplier retirees. Peggy and Dave volunteered to assist. Peggy will investigate phone number, routing number and/or chat room options.

TREASURER'S REPORT – Yvonne Merritt

Funds will be transferred from PayPal to Comerica, but a $25,000 balance is required to be maintained in PayPal. The accounting system has moved to QuickBooks Pro and there are now three logins for treasurer, administrator and sponsorship chair.

The account total is $148,169 divided as follows:

Checking: $23,782
Savings: $27,410
PayPal: $71,977

COUNCILOR'S REPORT – Tom Pickett

No council meetings have been held since the last board meeting. Tom will submit the SPE Automotive Div.'s question on liability insurance for directors and officers at the ANTEC council meeting.

ANTEC – Anthony Gasbarro

Anthony provided an update.

MARCOM – Peggy Malnati

AutoEPCON: Attend May 6, 2014 at the Troy Management Education Center.
ACCE: Sept. 9-11, 2014.
IAG: Nov. 12, 2014. The working tagline was modified to *Plastics Pay Off.* The board judging dates are Oct. 2-3 and the Blue Ribbon judging date is Oct. 13. For reference the TPO conference is Oct. 5-8. Lifetime Achievement and Hall of Fame nominations are needed.
SPE AD Online: January's web traffic (35,760 unique visits) was the highest January on record.

NEW BUSINESS/OTHER

- Next meeting: Monday, April 14, 2014.
- Yvonne, Dawn and Peggy will meet offline and return with a succession plan, particularly for key positions. Treasurer and House positions need to be filled.
- Peggy will distribute cards for Ed and Jackie for members to sign.
- Dawn indicated the need to find a full-time job by the start of the next school year (Sept. 2014). She normally works 10-15 hrs/week and up to 40 hrs/ week during the busy season surrounding ACCE. Dawn offered to train whoever is hired as a replacement.

TREASURER'S REPORT

by Dawn Stephens

Current finances for the SPE Automotive Division remain healthy. As of May 15, 2014 we have $201,080.21 in checking, $27,421.55 in savings, and $10,000 in PayPal, for a total of $238,501.76 USD

SECRETARY'S REPORT

SPE Automotive Division Board
April 14, 2014 Minutes

Next BOD Meeting: Monday, June 23, 2014

ATTENDEES

Yvonne Merritt	Jeff Helms	Al Murray	Suresh Shah
Peter Bejin	Mark Lapain	Tom Pickett	Mike Whitens
Teri Chouinard	Edward Luibrand	Monica Prokopyshen	Steve VanLoozen
Fred Deans	Peggy Malnati	Nippani Rao	Maheen Kahn
Brian Grosser	Mike Masserant	Elias Shakour	

Meeting was held at ACC in Troy, 5:30 p.m. – 8:04 p.m.

EDUCATION – Monica Prokopyshen

The SPE AD held 3 *Designing with Plastics* workshops March 26, 2013 at Cranbrook Kingswood Middle School as part of Explorathon™ 2014. Moderators included Elizabeth Johnston, Monica Prokopyshen, and Marjorie Weiner. Barbara Cochran represented the American Association of University Women (AAUW), which organizes the Explorathon.

SOCIAL – Teri Chouinard

Teri proposed having the next social event at the Michigan Science Center in Detroit and inviting science and engineering students. The center has a STEM program and the nearby historic Scarab Club has good food. Teri will contact the colleges to see how a late May / early June event fits with their schedules.

MEMBERSHIP – Steve VanLoozen

There were 38 respondents to the survey: 94% were current SPE members; 45% have been members for over 15 years; 30 of 38 respondents worked in the auto industry and 4 were Transportation/Other members. Respondents comprised OEM, Tier 1, Tier 2, and supplier employees; 79% said employers pay their dues; 28 of the 38 already recommend SPE membership to others.

The top two answers to "**What provides the most value?**" were:

#1 In-person networking: conferences, social /dinner meetings and plant tours.

#2 Job opportunities (assistance in finding job, improving employability, job postings)

What would you like to see? High value was associated with technical papers online. The SPE AD needs to increase awareness on where to find and how to access the online technical papers. Computer demonstrations at networking meetings and conferences were suggested.

The SPE AD membership has risen in contrast to the membership reductions in the society as a whole. The average retention for new members is 80%.

TREASURER'S REPORT – Yvonne Merritt

A motion was passed to increase Dawn Stephen's (independent contractor) work from 15 hrs/week ($12.5 K/yr) to $30 K/yr for one year. Dawn will assume the Treasurer's duties. SPE AD will pay her membership to allow her to serve as Treasurer. Two BOD members will monitor performance and the process and will approve her bills. The change is effective April 15th, 2014.

Account balances as at April 17, 2014 are:

Checking: $162,644
Savings: $27,410
PayPal: $59,473
Total: $249,527

COUNCILOR'S REPORT – Tom Pickett

No council meetings have been held since the last BOD meeting. Tom will submit the SPE AD's question on liability insurance for directors and officers at the ANTEC council meeting.

ANTEC – Anthony Gasbarro

14 papers have been received and reviewed.

MARCOM – Peggy Malnati

AutoEPCON: Event is May 6, 2014 at the MSU Management Education Center in Troy. Our ad swaps are running.

ACCE: Sept. 9-11, 2014. Three releases have been distributed. 63 paying sponsors and 20 media sponsors are confirmed; the exhibit space was sold out and additional space was procured; 42 abstracts have been received; Jay Baron and Elias Shakour of CAR are organizing an executive panel session.

IAG: Nov. 12, 2014. The tagline is *Plastics Pay Off.* The first press release was issued. The BRJ and BOD judging dates have been set. Duplicate trophies from last year's event are still being sold.

SPE AD Online: January's web traffic (35,760 unique visits) was the highest January on record. August 2013 (55,163) retains the record for highest volume overall. SPE AD doesn't pay for position. The blog has 1,044 followers and Twitter has 995.

Plastics for Life Global™ Parts Competiton: Three SPE AD board members participated on SPE headquarter's sub-committee, which developed this global parts competition. The award categories are:

- Sustaining Life
- Improving Life
- Protecting Life
- Quality of Life
- Grand Award

Upcoming Events: Volunteers are requested to man the SPE AD booth at several new multi-material lightweighting events in the area in May. Contact Peggy Malnati.

Lightweighting Summit: New Solutions…New Suppliers – May 20-21 (Detroit Doubletree Suites)

Global Lightweight Vehicle Manufacturing Congress 2014 – May 28-29 (Troy Marriott)

SPE AD Newsletter: 900 newsletters were mailed in March. In addition, there were 3,500 downloads of the March issue. The deadline for articles for the June issue is May 15. Authors for key columns are: David Hunt (An Engineer's Life), Al Murray (Service through Science), and Herm Dillon, Automotive Newswire, (Batter's Box). The June technical article is the Moldex3D's award winning ACCE '13 paper.

SPONSORSHIP – Teri Chouinard

There are 9 newsletter sponsors totaling $32,700.

NEW BUSINESS/OTHER

- Next meeting: Monday, June 23, 2014.
- The storage unit is no longer required so it will be emptied. Savings will be $215/month.
- Peggy will follow-up on providing Marjorie Weiner a banner for Plastivan use.
- The Fred Schwab archives need to be reviewed and digitized as appropriate.
- Determine the required document retention periods for SPE AD tax records.
- SPE International's new website was live April 22nd. http://www.4spe.org/

SOCIAL REPORT

Teri Chouinard,
SPE Automotive Div. Social Chair

GM Heritage Center Tour for Automotive Plastics Professionals and Students

The next SPE Automotive Division social event will include a tour of the General Motors (GM) Heritage Center in Sterling Heights, Michigan, followed by networking and pizza and beverages at Rosie O'Grady's restaurant. The tour is scheduled for Wednesday, June 25, 2014 starting at 3:00 p.m., and networking with informal presentations on the benefits of SPE membership will follow from 4:30 -7:00 p.m. The GM North American Heritage Collection is made up of approximately 600 cars and trucks. Many reflect GM's industry firsts, like the first electric self-starter used on the 1912 *Cadillac*, the first production V8 that powered the 1915 *Cadillac*, and the first airbag, found on 1974 *Buick*, *Cadillac*, and *Oldsmobile* models. Others are technological experiments like the first American gas turbine-powered car, Firebird 1, or the world's first hydrogen fuel cell-powered vehicle, the 1966 *Electro-van*. Concept cars and special-interest styling/performance one-offs are part of the mix, along with significant race cars and milestone production vehicles such as the first production 1966 *Oldsmobile Toronado* featuring General Motors' front-wheel drive. The GM Heritage Collection is ever-changing. New vehicles are constantly being obtained to fully represent GM's product story of the past 100+ years.

The event is free to SPE members and guests who may be interested in joining SPE – including students interested in learning about the benefits of becoming an SPE member and working in the automotive plastics industry. The tour, pizza, and non-alcoholic beverages are included at no charge.

SPE Automotive Div. members representing automakers, tier suppliers, and other professionals in the industry will be participating to enhance networking opportunities for participating students and to discuss career opportunities available in the field of automotive plastics.

Pre-Registration is required. See our easy online registration page at **http://spead-social.com/**.

The GM Heritage Center is located at 6400 Center, Sterling Heights, Michigan 48312. It is on the east side of Mound Road, between 16 Mile (Big Beaver) and 15 Mile (Maple) Roads. Rosie O'Grady's is across the street, at 36759 Mound Road.

SOCIAL REPORT Continued from page 39

SPE Automotive Division 2014 Golf Outing

The 2014 SPE Automotive Div. Golf Outing will once again be held at Fieldstone Golf Club in Auburn Hills, Michigan on September 8 – the day before the SPE Automotive Composites Conference & Exhibition (ACCE), which gives conference attendees an opportunity to relax and get an early start on entertaining. Sponsors to date include: PETS – Plastics Engineering & Technical Services, Inc., PolyAd Services, and Addcomp North America. This outing is a great opportunity to meet new people, visit with customers, or just get out for good company and fresh air. To keep things lively and interesting, there are a number of sponsorship opportunities for various contest holes, lunch, and dinner. The sponsorship packages include foursomes (with breakfast, lunch, and dinner) signage, keepsakes flags with corporate logo, event recognition including logo on division website, and recognition in SPE communications.

The purpose of Automotive Division's social events is to nurture networking, have fun, and build membership. If you have an idea for a social event, which may include a tour of your facility or other educational and fun ideas that will interest our membership and draw new members, please email teri@intuitgroup.com or call 810.797.7242. See the flier on the next page for more details.

SPE Golf Outing 2014

SPE® AUTOMOTIVE

Drive Home a Powerful Marketing Message With a Hard-Hitting Sponsorship Program

2014 Sponsorship Opportunies

There are a number of promtional opportunites available for this year's SPE Golf Outing.

Type of Sponsorship:	Cost:	Benefits Include:
Contest Hole	$1000. USD	1 foursome, signage, flag & more
Hole	$750. USD	1 foursome & signage
Lunch	$2000. USD	2 foursomes, signage & 100 fliers printed & ditributed at the event promoting sponsoring company or its products
Dinner	$3000. USD	3 foursomes, signage, company message / logo on dinner table centerpieces, 100 fliers printed & ditributed at the event promoting sponsoring company or its products

http://speautomotive.com/golf

Contact Teri Chouinard for more details.

Intuit Group • Ph 810.797.7242 • Fax 810.797.7243

teri@intuitgroup.com

Monday, September 8 2014

Fieldstone Golf Club
1984 Taylor Road
Auburn Hills, MI 48326
USA

Cost:
$500. USD / Foursome
$125. USD / Player

Program:
8:30 am – Sign-in & Continental Breakfast
10:00 am – Shotgun Start
Box Lunch at Turn
3:30 pm – Buffet Dinner
4:00 pm – Awards & Prizes

FIELDSTONE GC
CITY OF AUBURN HILLS

EDUCATION REPORT

by Monica Prokopyshen, Education Chair

The Explorathon™ is an annual event of the American Association of University Women (AAUW), Birmingham Branch, whose purpose is to "To provide students with interactive and hands-on workshop sessions featuring dynamic women scientists, engineers, mathematicians, and health-care specialists; and to showcase opportunities for women in scientific careers." The event is open to SE Michigan students from grades 8 – 12. Some students we taught in the past have gone on to plastics studies, and recently we've begun to meet them at Detroit Section and Automotive Division (SPEAD) events.

Our division has hosted Explorathon workshops for 15 consecutive years. Our participation is made possible by member support of division events as well as donations of display/teaching materials and handouts from members' companies.

On March 26, 2014 we hosted three hands-on workshops covering: "Chemistry and Designing with Plastics." Cranbrook Kingswood Middle School was available for the day-long event and we appreciated the well-appointed chemistry lab made available for our use. The following individuals participated in this year's workshops: Barbara Cochran (AAUW); Elizabeth Johnston (Ford Motor Co., SPEAD); Monica Prokopyshen (SPEAD); and Marjorie Weiner (PlastiVan™ Education Program). About 50 students attended.

SESSION RATINGS %

Your interest in this session	92
Presenter's content and materials	96
Presenter's presentation style	90
Your overall evaluation of this session	96

ATTENDEES BY GRADE %

8th	4.5
9th	22.7
10th	22.7
11th	18.2
12th	15.9
Undeclared	14.6

There was a wider understanding of chemistry this year among attending students. However, the proportion of students in grade 8 is down 50-60%. For 2014, organizers targeted older students in grades 9-12. One student who attended our session last year enjoyed it so much that she returned this year. She had many questions about university programs in polymer science even though she is still a couple of years away from college.

It was helpful having 4 volunteers to help manage students, equipment, and handouts, as well as teaching and providing assistance. The pace was rapid and packed with information. Feedback indicated that 22% of the students would have liked a longer workshop. Thanks to Celanese for the surplus "Ticona" bags, which were used for distributing handouts: SPEAD Education Outreach Summary; SPE lanyards; SPEAD pencils and newsletters; and ACCE CDs, notepads, and program guides. Students found "An Engineer's Life" and "Service through Science" articles handed out after the session to be interesting and valuable. Logistics could be improved and the articles more widely distributed if they were combined into a pamphlet in the future.

WRITE-IN COMMENTS

There was lots of interest in why and how things worked. Students really enjoyed the practical, everyday uses of polymers, and we had many comments that they enjoyed learning how plastics were manufactured as well as the variety of forms and uses of polymers. The most popular answers to the two write-in questions are listed below.

1) What was most useful this session? (Answers are listed in most to least common order.)
   a) The hands-on experiments
   b) Everything
   c) Learning different ways plastics are used
   d) Interesting, educational and fun
2) What might have made it better?
   a) Nothing. It was very educational. Nothing really, it was fun!
   b) More experiments & more time/longer session
   c) Learning about the day-to-day jobs we might encounter (handed out 4 issues of Newsletters with "An Engineer's Life" and "Service through Science" articles)
   d) If we could keep what we made

Some PlastiVan™ visits will be carried over until next year due to a record number of school "snow days" and weather interruptions, which caused cancellations in the travel schedule.

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