Abstracts of Speaker Presentations 2014

Tuesday Morning, September 9: In Granite/Gold/Copper Room

OPPORTUNITIES & CHALLENGES WITH CARBON COMPOSITES – PART 1 OF 1:

Allan James
Dow Automotive Systems

High Speed RTM Materials and Processing Technology Advancements for Affordable Lightweight Composites

Up until now, production capacity of carbon fiber composite systems was limited due to the relatively slow curing reactions and the fundamental inability to de-convolute pot-life and cure speed associated with the thermoset resins typically used for these applications. New process technology and significant chemistry innovation, including addressing the right balance between rheo-kinetics and ultimate thermo-mechanical performance, have been required to deliver an economically viable thermoset system for use in the rapid processing environment associated with meaningful mass-production scenarios. This presentation will review the latest developments and performance of fast-curing high pressure resin transfer molding (HPRTM) resins to support this industry need.

Koichi Akiyama
Mitsubishi Rayon Co., Ltd.

Utilization of PCM Technology with Various Applications of Commercial Production Vehicle

Prepreg compression molding (PCM) technology has been developed as a high-cycle molding process suitable for CFRP automotive applications with high production volumes. Several applications developed by PCM technology have been implemented with commercial production vehicles and the production of these parts has started recently. This talk discusses utilization of PCM technology with commercial applications and its advantages observed from actual part production

Hendrik Mainka, Volkswagen AG
Liane Hilfert, University of Magdeburg

Lignin — An Alternative Precursor for Sustainable & Cost-Effective Automotive Carbon Fiber

The analysis of lignin as an alternative precursor enabling a significant reduction in the cost of CFRP and reduction of CO_2 emission during carbon fiber production is essential to make carbon fiber ready for a mainstream use within the automotive industry. Key aspects are: the examination and quantification of lignin as an alternative precursor; the optimization of the manufacturing processes; the characterization and quantification of the properties of the novel carbon fibers within an established material pre-validation process; and a final economic efficiency and sustainability analysis. Main issues for successful implementation of lignin-precursor carbon composites in future lightweight vehicle concepts that also will need to be addressed include processability as well as demonstrations of the suitability of these materials for high-volume production.

DOUBLE-LENGTH PRESENTATION
Louis Dorworth
Abaris Training Resources

Inspection and Damage Repair of Advanced Composite Automotive Structures

This talk will provide a comprehensive overview of damage detection, damage removal, and repair methodologies for repairing carbon fiber reinforced polymer (CFRP) composite structures. The presentation will begin with an overview of various non-destructive inspection (NDI) techniques employed within the industry. Special emphasis will be given to next-generation ultrasonic equipment and related documentation software. The author also will examine the primary approach to large-section repair, the complications that are presented using this approach, as well as alternative repair schemes that make sense for smaller, localized areas of damage to these structures. This presentation is intended to be an interactive event, encouraging audience participation. Topics will include: damage detection using the latest non-destructive inspection (NDI) methods; large-section removal and replacement using adhesive bonding approach; alternative tapered scarf repairs to smaller, localized areas of damage; and common materials and equipment used for repairs to CFRP structures.

Tuesday Morning, September 9: In Emerald/Amethyst Room

VIRTUAL PROTOTYPING & TESTING OF COMPOSITES – PART 1 OF 3: Simulations with Discontinuous Reinforcements

Srikar Vallury
CoreTech System (Moldex3D) Co., Ltd.

Prediction of Fiber Microstructure for Injection Molding: Orientation, Degradation, and Concentration

For injection molding simulation of fiber-reinforced thermoplastics, this work aims to carry out the fiber microstructure analysis, including fiber orientation, fiber length, and fiber concentration. In particular, long fiber degradation represents a major problem of fiber length attrition because of processing from screw through entering into the cavity. It is significant to investigate the famous shell-core structure of fiber orientation with respect to fiber length and fiber concentration. Furthermore, these predictive results are in good agreement with related experiments.

Abstracts of Speaker Presentations 2014

Kurt Danielson
e-Xstream engineering

Stiffness and Failure Modeling of Discontinuous Fiber Composites

2014 SPE ACCE Dr. Jackie Rehkopf Best Paper Award Winner

Discontinuous fiber composites (DFC), also known as chopped tape reinforced composites, are fairly new and increasingly used in the automotive industry. The challenge of designing structural parts with DFC lies in the lack of control that engineers have in handling their significantly varying stiffness and strength behaviors. On one hand, the discontinuous chopped tapes are several millimeters long (10 to 100 mm), thus of the same order as the size of structural parts and their geometric features. On the other hand, their strength is much related to the interfacial behavior between and at tips of tapes, which varies as a function of the tape orientation and the intertwinement between tapes. Those two factors combined together can lead to significantly varying properties from parts to parts due to the various configurations tapes can adopt within the different positions of a given geometry. In this framework, a numerical solution for modeling DFC was developed. The developed capabilities enable stiffness and strength of DFC composites to be evaluated under various microstructure configurations. The developed tools will be presented and computed stiffness and strength will be compared against test data presented in literature.

Nicholas Smith
Purdue University

Use of Orientation Tensors in Homogenized Material Properties of Discontinuous Composites

2013 SPE ACCE Scholarship Award Winner

The material properties of discontinuous composite materials depend on the orientation state of the fibers. This orientation state is conveniently described in molding simulations as a second-order orientation tensor defined by Advani and Tucker. The recovery of an orientation distribution function from this orientation tensor is necessary to determine the homogenized material properties, and in this work a Fourier series approximation is compared to a numerical optimization method. Both are utilized in a Mori-Tanaka homogenization algorithm to compare the effect of the Fourier smoothing on predicted material properties.

Cuntao (Philia) Wang
Kyoto Institute of Technology

Adhesive Property of Insert-Injection Molded Glass Fiber Reinforced Thermoplastics

Insert-injection moulding was used to fabricate glass fiber-reinforced thermoplastic dumbbell samples with different length of adhesive interface. The Instron universal test machine with temperature chamber was used in order to investigate the effect of test temperature on the mechanical property of adhesive samples.

Mike Matthews
PCCR USA, Inc.

Core-Shell Critical Damage & Recovery Properties

A novel approach to reduce fatigue cycling damage, impact resistance, and crack propagation in composite structures is presented.

Tuesday Morning, September 9: In Bronze/Silver Room

NANOCOMPOSITES – PART 1 OF 2: Graphene, Attapulgite, and New Assessment Tools

David Arthur
SouthWest NanoTechnologies, Inc. (SWeNT)

Carbon Nanotube Materials for Automotive Applications

For CNTs to be commercially successful, it is essential that 5 critical factors be addressed: structure, purity, integration, scalability, and value. The author will discuss 3 automotive applications that are currently the focus of commercialization efforts: 1) printable, thermo-formable, transparent capacitive touch sensors to replace membrane switches in automotive interiors; 2) supercapacitors with enhanced low-temperature performance and higher power density; and 3) polymer composites with enhanced electrical conductivity, thermal conductivity, and mechanical properties.

Charles Dal Castel
University of Waterloo

Engineering Polymers / Attapulgite Nanocomposites

This work presents the development of nanocomposites comprised of engineering polymers and a needle-like inorganic nanofiller (attapulgite) using different preparation methods (via direct extrusion (melt-mixing method) as well as with dissolutions of polymers (the solution method)). The thermal and mechanical properties of nylon 6, nylon 6/12, and polycarbonate nanocomposites reinforced with attapulgite are presented. Addition of a relatively small percentage of attapulgite to the thermoplastic matrix improved mechanical properties and that will be of interest for automotive applications because of the opportunity for weight savings in molded parts. In addition to applications in injection molding, this work also will discuss application of these nanocomposites in fused deposition modeling (3D printing) for prototyping.

Keith Honaker
Michigan State University

Processing Methods of High Density Polyethylene- Exfoliated Graphene Nanoplatlet Nanocomposites for Automotive Fuel Tank Applications

2013 SPE ACCE Scholarship Award Winner

2014 SPE ACCE Dr. Jackie Rehkopf Best Paper Award Winner

High-density polyethylene (HDPE)–exfoliated graphene nanoplatelet composites were synthesized and tested to measure their mechanical and barrier properties. To overcome limitations of melt extrusion, multiple processing techniques were investigated, including microlayer co-extrusion and solution mixing with sonication. Additionally, multiple modifications to the nanocomposites constituents were investigated, including cryo-milling the HDPE pellets and coating the platelets with a wax or polyolefin elastomer before extrusion processing.

Abstracts of Speaker Presentations 2014

Carter Kittrell
Rice University

CVD Growth of Graphene

Graphene is a two-dimensional (2D) sheet of carbon atoms in a hexagonal array. It has attracted considerable research interest due to its remarkable physical and chemical properties, including the very-high strength of the sp2 hybridization, very-high carrier mobility, and its thermal conductivity. A single layer is conductive, yet 98% transparent to visible light. While small graphene flakes can be obtained from naturally occurring minerals, sheets of graphene may also be grown via chemical vapor deposition (CVD). Such bottom up, rather than top down, synthesis allows for a large variety of new materials, including a perfect single crystal one atomic layer thick forming a hexagon a few millimeters across or with several stacked layers of single domains; it also can be polycrystalline covering the substrate. Porous nickel foam will yield a 3D polycrystalline graphene matrix. Carbon nanotubes may be grown vertically from the surface to provide enormous electrode surface area, or spread horizontally to make "rebar-stiffened" graphene. The graphene may be functionalized with many types of ligands to change properties, make it water soluble, and change the Fermi level. Atom substitution provides doping and carriers. It is promising for transparent conducting films, battery electrodes, tiny supercapacitors, as well as a reinforcing material that can also prevent gas permeation. The emphasis in this presentation will be on methods of synthetic production of graphene.

W.H. Katie Zhong
Washington State University

Industry Applicable Nanotechnologies: Approaches to Enhancing Quality and Stability of Nano-Systems and Quantitative Assessment Tools
Plenary Talk

To scale-up many promising lab-scale "nanotechnologies," one of the big limitations is related to quality assessment and control. In this talk, several industry applicable nanotechnologies that have been investigated will be introduced: (1) a bio-approach for nano-filler treatment; (2) viable nanodispersion approaches for manufacturing stable and uniform quality and controllable nanocomposites; (3) and quantitative assessment tool sets including an industry friendly macro-dispersion evaluation method, a non-destructive analysis (NDA) method, and a damage-detection approach. In addition, the author will also briefly introduce her newly developed gummy electrolyte with high ionic conductivity of liquid level, good mechanical properties of solid level, and excellent contact/adhesion with electrodes, as well as special thermal protection design for promoting safety of LIBs. The novel gummy electrolyte will have great potential for use in electric vehicles and other applications with high safety requirements.

Tuesday Afternoon, September 9: In Granite/Gold/Copper Room

BUSINESS TRENDS & TECHNOLOGY SOLUTIONS – PART 1 OF 1:

Alexander Auken
Cytec Industries Inc.

Increasing the Affordability of Continuous Fibre Composites for High Volume Production

The increasingly tight legislative CO_2, fuel economy, and emission targets, coupled with emerging life cycle analysis (LCA) legislation continually challenge the automotive industry, but aluminum body-in-white (BIW) structures and new powertrain technology developments are not sufficient to meet these challenges, allowing composites to come to the forefront. The rate of change in the automotive industry is rapid, with a proliferation of carbon composite structures in an increasingly large number of vehicle programs. Mixed material BIW solutions are the target, offering the necessary balance of mass reduction with composite design for manufacture and joining technologies – i.e. using the right material in the right place on the right application for serial production volumes. Affordable carbon-composite-intensive structures at high volume require not just the right performance from new materials, but automation, scrap reduction or re-use, and an OEM vehicle architecture that evolves with the technology developments. This talk presents technology advancements to address these issues, and suggests effective solutions to the automotive paradigm.

David Evers
Momentive Specialty Chemicals Inc.

Comparison of Engineering Thermosets to Conventional Materials for Automotive Under-the-Hood Applications According to Life Cycle Assessment (LCA)

Momentive is beginning to institute life-cycle analysis (LCA) for product design. This presentation on an LCA for a thermoset composite water pump is the first in a series of LCAs and discusses findings to date and the process of LCA.

Akio Ohtani
Gifu University

Society of Automotive Composite in Japan

In the automobile industry, weight reduction of car bodies is being tried in order to reduce fuel consumption. Composite materials as represented by carbon fiber reinforced plastics (CFRP), which have superior specific stiffness and strength, have been expected to be used for the car body instead of metal parts. However, there are a lot of new technical problems required for mass-production of car parts with composite materials. One of the issues seems to be that processes and required mechanical properties for the composite structural materials were focused on aerospace applications and these are completely different from those for automotive composites. In order to solve these problems, the Society of Automotive Composite (SAC) was established in March 2012 in Japan. Solutions for the problems are that material, molding, and structure for automotive composites must be designed just for automotive usage. Therefore, not only automotive companies, but many material suppliers and molding companies also have joined SAC. This year, joint research work between SAC, automakers, and other companies has included development of intermediate materials for thermoplastic composites with short fibers or continuous fibers; continuous molding for mass production of FRP; basic research work for interface and interphase, etc.

Abstracts of Speaker Presentations 2014

Sophie Rabeau
Institut Supérieur de Plasturgie d'Alençon - Pôle Universitaire de Montfoulon

End-of-Life Vehicle (ELF): Development of a New Recycled Material

Between now and 2015, French national legislation will compel all automakers selling vehicles in the country to increase their recovery rate for end of life vehicles (ELVs) to 95% and their recycling rate to 85% by weight owing to European mandates. As part of the European program LIFE, the ICARRE 95 project is studying technical solutions to meet those goals. Following previous work on sampling-method development to control quality of material received and selection of the most adequate supply source, a new study has been conducted to determine adequate formulation with this supply source to reach initial product specification. The work has enabled development of a detailed global method that couples sampling methodology, and formulation and process optimization to allow substitution of virgin material with recycled plastics from ELVs.

Tuesday Afternoon, September 9: In Emerald/Amethyst Room

VIRTUAL PROTOTYPING & TESTING OF COMPOSITES – PART 2 OF 3: Laminate & Fabric Simulations; Modeling Pultrusion

Sarah Stair
Baylor University

Non-Destructive Characterization of Ply Orientation and Ply Type of Carbon Fiber Reinforced Laminated Composite

2013 SPE ACCE Scholarship Award Winner

While fiber reinforced composites are a high-strength, low-weight alternative to metals, the manufacturing and repair of such components is more complex. The need for non-destructive testing methods to characterize the as-processed ply configuration compared to the as-designed ply configuration will become essential in next generation vehicle quality control and maintenance. This presentation will discuss work that focuses on a novel ultrasonic C-scanning technique that incorporates a patent-pending ply detection algorithm to determine the ply type, orientation, and thickness of each lamina in a carbon fiber-reinforced laminated composite.

Kurt Danielson
e-Xstream engineering

Progressive Failure of CFRP Coupons and Automotive Parts

2014 SPE ACCE Dr. Jackie Rehkopf Best Paper Award Winner

Continuous fiber reinforced plastics (CFRP), a category of composites, are considered to be the best choice for new concepts in automotive for parts submitted to the most severe loads. The simulation must then be able to reproduce the correct failure behavior of the composite for safety purposes. The aim of safety simulation is not only to detect the initiation of damage in the material, but to describe correctly its post-failure behavior. This presentation will address the application of multi-scale material modeling strategy to the specific needs of post-failure behavior simulation of continuous fiber composite parts submitted to dynamic loads. The work will demonstrate how simulation can be improved, for safety design simulations in particular, in the automotive industry, helping to reduce design delay, cost and weight of the structures.

Dustin Souza
e-Xstream engineering

End-to-End FE-based Homogenization of Woven Composites

2014 SPE ACCE Dr. Jackie Rehkopf Best Paper Award Winner

Woven composites are represented by interlacing yarns impregnated by a resin matrix. Yarns are made of a resin matrix reinforced by continuous fibers. Homogenization of woven composites therefore requires two levels of homogenization, the one of the yarn and the one of the ply. Finite element (FE) based homogenization at the ply level can be combined with mean-field homogenization at the yarn level to predict the mechanical behavior of a single ply. The main difficulty of this approach lies in the generation of a representative volume element (RVE) of a single ply. An end-to-end FE based homogenization of woven composites has been developed. A fully analytical framework based on mean-field homogenization also has been developed and interestingly this framework takes yarn curvature into account. The developed tools will be presented and the FE based and mean-field homogenization predictions of linear properties will be compared to experimental measurements on plain weave and 5HS woven composites

Uday Vaidya
University of Alabama at Birmingham (UAB)

Modeling & Experiments in Thermoplastic Composite Pultrusion

Thermoplastic pultrusion is an emerging process and has a number of applications such as profiles for structural elements for trucks, buses, and transportation components. The present work focuses on using a modeling approach for thermoplastic pultrusion while experimentally validating the models. Computer-aided design, finite-element analysis, and computational fluid dynamics software as well as analytical methods were used to model the pultrusion process. A pultrusion die was designed based on the amount of time required for E-glass/polypropylene hot-melt impregnated tapes to fully melt and consolidate in the die. A fluid simulation study was conducted to characterize how the processing parameter of die temperature and pulling speed affect the amount of force required to pull the material through the die. The results show that the pulling force increases as the pull speed increases. Both the fluid model and the experimental data show excellent correlation. The developed approaches can be extended to a variety of thermoplastic materials in glass, carbon, hybrids, and natural fiber composites.

Abstracts of Speaker Presentations 2014

Tuesday Afternoon, September 9: In Bronze/Silver Room

NANOCOMPOSITES – PART 2 OF 2: Carbon Nanotubes (CNTS) & Other Nanofibers

Brian Grady
University of Oklahoma

Carbon Nanotube-Polymer Composites: An Overview
Plenary Talk

Carbon nanotubes are, in many ways, similar to polymers. Both molecules have contour lengths typically on the order of 1 micron and, for single-walled tubes, diameters between 0.5 and 1 nm. In terms of physics, the significant difference between the two is the significantly larger inflexibility of a nanotube, which is quantified by an orders-of-magnitude larger persistence length. This presentation will describe how nanotubes and polymers interact with one another in composites of the two materials. The author also will discuss how these physics affect commercial products that contain nanotubes, and finally will describe the challenges that still remain in terms of increasing the use of carbon nanotubes in commercial products.

W.H. Katie Zhong
Washington State University

Reduced Viscosity Nanofiber Technology Leading to Enhanced Mechanical Properties and Lower Viscosity for Improved Infusion Processing of Composites

A "nano-nectar" technology developed in the author's lab not only effectively enhances multiple mechanical and thermal properties, but also dramatically reduces viscosity of base resins via a simple mixing process. The good wetting and adhesion capability of the resulting resins (lower viscosity and long shelf-life) to the fiber reinforcement are significant for the manufacturing energy efficiency (reduced power requirements for flow and part consolidation) for fiber-reinforced composites.

David Lashmore
University of New Hampshire

Boron Nitride Continuous Fibers

New generations of nanotube fiber are becoming available based on carbon or boron nitride. Significantly, boron-nitride nanotube (BNNT) continuous fiber has the potential to surpass carbon nanotube (CNT) yarns and potentially even graphite fiber in terms of mechanical properties. This presentation will focus on boron nitride, reviewing properties, means of production, and structure. The properties of individual BN nanotubes suggest extraordinary mechanical performance even at 900C in air. Their large band gap suggests that these are insulators; however, boron nitride is one of the few materials whose band gap can be tuned externally or, like carbon nanotubes, by doping. A new high temperature process to synthesis BN yarn using a chemical-vapor deposition (CVD) reactor at rates that should lower costs will be described. These properties will have a 'game changing' effect on fundamental design of: (1) high-temperature composites, (2) a new kind of BN-BN composite analogous to a C-C composite used at very-high temperatures, (3) transport properties (e.g. tunable electronic properties that offer a sophisticated handle on conductivity), and finally (4) a structural material combining the multifunctional characteristics of extraordinary strength and modulus, and very-high fracture toughness, all with radiation shielding.

Srinagesh Potluri
Zyvex Technologies

Gen II: Carbon Nanotube Delivery System for Improving Mechanical Properties of Fiber Reinforced Composites

The Gen-II technology presented in this report enabled efficient delivery of carbon nanotubes and nanoclays into various resins. Fiber-reinforced polymer composites were fabricated by sheet-molding compound (SMC), filament winding, vacuum infusion, and prepreg processes without changing the manufacturing processes. Mechanical properties such as Izod impact, modulus, and fracture toughness showed a 20-30% improvement by adding 10 phr of the Gen-II technology.

Tuesday Afternoon, September 9: PANEL DISCUSSION In Diamond Ballroom

Lightweighting & the Multi-Material Car
Moderator: Jay Baron,
Center for Automotive Research
Panelists: to be announced
Not available at press time.

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Wednesday Morning, September 10: In Granite/Gold/Copper Room

ADVANCES IN THERMOSET COMPOSITES – PART 1 OF 3: Sheet-Molding Compounds

Scott Lewit
Structural Composites, Inc.

Strain Tunable Resin and Coating Technology for Next Generation Composites

A patent-pending, breakthrough coating and resin technology for composites has been invented. This co-cure technology enables shop-floor alteration of coating and resin properties, which can facilitate a range of performance enhancements to composite fabrications. This technology has won numerous awards, including the National Innovation Award and the Tibbett's Award as it has the potential to impact the entire composites market, allowing for more cost-effective optimized composite structures. This presentation will discuss the technology's potential impact on the transportation market.

Abstracts of Speaker Presentations 2014

Michael Sumner
Ashland, Inc.

Customer-Driven Development of Low Density Class A SMC with Improved Mechanical Properties

There is a very high interest in "lightweighting" in the automotive industry due to pending U.S. CAFE 2025 regulations regarding increased fuel economy. There are a myriad of approaches and paths to achieve lighter vehicles, including lower density versions of existing materials. However, as the density of existing materials has been reduced, this has resulted in a deleterious effect on physical properties or "toughness." As a result, there is a clear need to develop lower density materials with increased physical properties. A brief summary of a marketing study aimed at defining critical properties and unmet needs at the OEM and tier level will be presented as well as recent product development efforts that have resulted in development of a tougher low-density Class A SMC.

Jeff Klipstein
AOC, LLC

Advances in Low Density SMC for Automotive Class A Applications

Today the automotive market is pursuing lighter weight materials to reduce the overall mass of the vehicle and improve gas mileage. Earlier, it had been shown that a lower density sheet-molding compound (SMC) based on fiberglass and unsaturated polyester technology could be manufactured with sufficient mechanical properties, although use of such materials had been limited to structural or non-Class A applications. Recent advances have shown that a Class A surface with acceptable mechanical properties can be achieved in a 1.2 specific gravity, low-density SMC system based on fiberglass and unsaturated polyester technology. This presentation will compare earlier advancements with recent improvements to lower density Class A SMC systems, and will provide insight into future work that is currently in progress.

Christoph Keckl
Fraunhofer Institute for Chemical Technology

Characterization and Quality Control of Sheet Molding Compound Maturation by Paste Viscosity Measurements

Sheet-molding compound (SMC) enables the production of exterior body parts for automotive applications with high-dimensional accuracy and Class A surfaces. The manufacturing process itself is divided into the production of SMC mats and compression molding with subsequent post-processing. Viscosity of the SMC mats has an important influence on the molding process as well as component properties such as fiber orientation and surface quality. Increase in viscosity during maturation caused by the use of magnesium oxide, which reacts with the unsaturated polyester resin and styrene in the SMC paste, is an applied quality criterion for SMC mats. This talk presents an innovative and simple method of discontinuous measurement of the viscosity increase of highly filled SMC pastes allowing for quasi-parallel rheometry measurements during the maturation process. Further, the influences of temperature, thickener content, and filler moisture on viscosity are investigated. It is shown that by measuring the initial viscosity increase, the further viscosity curve can be anticipated for a certain range of thickener contents and temperatures.

(Break)

Wednesday Morning, September 10: In Granite/Gold/Copper Room

ADVANCES IN THERMOSET COMPOSITES – PART 2 OF 3: Epoxies

Roman Hillermeier
Momentive Specialty Chemicals Inc.

Automotive Composites "Crash Box" for Mass Production

Initial applications by high-volume producing OEMs have yet to take full advantage of CFRP properties, especially in structural body applications. Cost, processing speed, and predictability of the molded part in crash situations have been concerns. This presentation explores recent work on the concept for a "crash box" that can be rapidly produced, provides aerospace-equivalent performance, and can be cost-effectively integrated into passenger car designs.

Stephen Greydanus
Momentive Specialty Chemicals Inc.

Prepreg Compression Molding for High Volume Manufacturing of Lightweight Epoxy Automotive Structures

Strategies for reducing the weight of modern car bodies involve greater use of composite materials. New manufacturing technologies in combination with new materials are providing high-performing, high-volume-capable, and cost-efficient solutions that were previously unavailable. Epoxy resin systems with cure times of less than 2 minutes are already in use today for processes such as liquid compression molding and high-pressure resin transfer molding (HP-RTM) techniques. Although these processes will play an increasingly important role in serial automotive production, others such as conventional compression molding may be better suited for a given part due to its geometry, volume, or performance requirements. This presentation describes a new fast-cure epoxy prepreg resin technology developed to give cure times of less than 5 minutes while using conventional compression molding processes. The resin systems provides excellent mechanical and thermal-mechanical properties with glass transition temperatures that can be adjusted in a range of up to 160C. In addition to being suitable for structural applications, the prepreg resin systems also provide high out-of-the-mold surface quality, which can significantly reduce the cost of post-processing on Class A exterior panel applications.

Kumar Kunal
Evonik Corp.

Optimized Epoxy Resins for Automotive Composites: Tough, Stiff & Fatigue Resistant

This presentation describes the benefits of using core-shell rubber tougheners and silica nanoparticles to modify epoxy resins to achieve improvements in toughness and stiffness, and also to have outstanding fatigue performance, which, in turn, increases service life. Moreover, parts made with such modified resins have superior surfaces that can be painted right out of the mold.

Abstracts of Speaker Presentations 2014

Wednesday Morning, September 10: In Emerald/Amethyst Room

ADVANCES IN THERMOPLASTIC COMPOSITES – PART 1 OF 2: Acetal and Polyamides

Duane Emerson
Celanese

All-Thermoplastic Composite Hydrogen Storage Cylinders for Fuel-Cell Powered Passenger Vehicles

Transportation OEMs face increased pressure to improve the fuel efficiency and reduce tailpipe emissions of their vehicles. Hydrogen fuel cells offer the possibility of creating zero-emission vehicles (ZEVs) from a safe and globally available energy source, but cost-competitive, high-performance storage and delivery solutions for hydrogen need to be developed to improve on current pressure vessel performance and allow for broad uptake of hydrogen as a fuel option. A multi-partner consortium has taken on the task of developing an all-thermoplastic monolithic composite vessel based on rotomolded and composite overwrapped polyoxymethylene (POM) with unidirectional (UD) carbon fiber-reinforced tapes.

Chee Sern (Alex) Lim
INVISTA Engineering Polymer Solutions

Fabrication of Continuous Glass Fiber / Nylon 6,6 Thermoplastic Composite with Improved Mechanical Properties

Continuous fiber thermoplastic (CFTP) composites have recently gained significant interests in applications ranging from aerospace to automotive owing to its unique features that thermoset composites are unable to provide. However, issues associated with thermoplastic resins and molding processes lead to challenges in achieving economies of scale, causing a lower than expected acceptance of CFTP as a commercially viable, lightweight material to replace metal. A few key aspects to overcome this challenge will be discussed in this presentation along with potential solutions.

Paul Kane
DuPont Automotive

High Glass Transition Polyamide Overmolding Resins with High Weight Fraction Continuous Glass Fiber Reinforced Thermoplastic Laminates: Composite Solutions Providing Improved Stiffness, Light Weight, and Less Design Space

One of the performance challenges for thermoplastic glass fiber laminate + overmolding resin composite is meeting stiffness requirements for automotive applications at elevated temperature (typically 90C for automotive components such as a cross-car beams, liftgates, seating, etc.). This presentation will review properties of high glass-transition temperature (T_g) polythalamide (PPA) resins and their use as an overmolding resin with stamped continuous glass fiber polyamide inserts. High weight fraction (75%) continuous glass fiber thermoplastic laminate properties will be reviewed, including elevated temperature performance, mechanical property characterization for finite-element analysis (FEA), properties with humidity exposure, and processing guidelines. Computer-aided engineering results will also be reviewed showing stiffness (torsional and bending), and frequency analysis of a continuous glass fiber thermoplastic beam over-molded with PPAs and polyamides.

Vasant Pednekar
LANXESS Corp.

Composite Sheets make Ultra-lite Airbag Housing Possible

Lanxess and Takata jointly developed a passenger airbag (PAB) housing using composite sheet and 40% glass reinforced polyamide 6 (PA6) impact-modified resin by the standard injection molding process in one step. A weight saving of over 35% was achieved. This presentation gives an overview of the materials and the steps including simulation for achieving this ultra-light airbag housing

(Break)

Wednesday Morning, September 10: In Emerald/Amethyst Room

ENABLING TECHNOLOGIES – PART 1 OF 3: Injection Molding

Alexander Roch
Fraunhofer Institute for Chemical Technology

Investigations on Injection Molded, Long-Glass-Fiber Reinforced Integral Foams Using Breathing Mold

Foam injection molding (FIM) enables flexural rigidity to be increased by several hundred percent in comparison to standard injection molding using the same amount of material. During injection of a gas-loaded melt into the mold, integral foam occurs consisting of a solid skin and a foamed core over the entire cavity. This presentation analyzes the lightweight potential for automotive applications obtained by long-fiber thermoplastic (LFT) integral foams using breathing-mold technology. With this knowledge, a wide range of automotive parts, which are mainly exposed to bending loads, can be made lighter.

Mark Paddock
Arburg, Inc.

Hybrid Components: Innovative Process for Lightweight Construction and Automated Insert Over-Molding

Not available at press time.

Putinun Uawongsuwan
Kyoto Institute of Technology

Direct Fiber Feeding Injection Molding of Carbon Fiber Reinforced Polycarbonate Composites

The fabrication method of direct-fiber feeding (DFF) injection molding was introduced in this work as the new processing route for production of short-fiber-reinforced polymer composites. Carbon fiber-reinforced polycarbonate (CF/PC) composites with fiber loading content from 8 to 28.9 wt% were successfully fabricated. The average fiber length decreased with the increasing of number of feeding fiber and decreasing of matrix feeding rate. The tensile properties of CF/PC composites fabricated by the DFF process showed linear correlation and increased with increasing of fiber content.

Abstracts of Speaker Presentations 2014

Wednesday Morning, September 10: In Bronze/Silver Room

SUSTAINABLE COMPOSITES – PART 1 OF 2:

Minh Tan Ton-That
National Research Council Canada

Cost-Effect Biocomposite Solutions

The National Research Council Canada (NRC) has developed a number of practical solutions to help industry in the production of composites and biocomposites. This presentation will focus on the solutions related to the most challenging issues of cellulosic fibre biocomposites, namely moisture absorption and flammability. The NRC's innovative solutions allow cost reduction of raw materials while facilitating processing and enhancing the mechanical performance as well as moisture and fire resistance of these materials.

Fatimat Bakare
University of Borås (Sweden)

Morophological & Mechanical Properties of a Biobased Composite from a Lactic Acid Based Thermoset Resin & Viscose Fiber Reinforcement

2014 SPE ACCE Scholarship Award Winner

A lactic acid-based thermoset resin was produced from the synthesis of lactic acid and glycerol in two stages: in the first stage, oligomers were polymerized by direct condensation of lactic acid and glycerol and in the second stage, the oligomers were end-functionalized by the reaction of methacrylic anhydride. Then, regenerated cellulose fiber was used to produce thermoset composites from the lactic acid-based resin synthesised. DMTA, flexural, tensile, and Charpy impact tests were performed to investigate the fiber alignments and fiber loads effect on mechanical and aging properties by aging in high humidity climate chamber. These composites can have multiple applications, but will be used in automotive applications, which will be advantageous in energy savings due to their low weight.

Alper Kiziltas
Ford Motor Co.

Sustainable Polyamide Composites

2012 SPE ACCE Scholarship Award Winner

It is possible to produce fully or partially bio-based composites of cellulose fibers in polyamides with melt compounding followed by injection molding. Overall, the composites reinforced with cellulose fibers display enhanced tensile and flexural properties in comparison with the neat polyamides.

(Break)

Wednesday Morning, September 10: In Bronze/Silver Room

SUSTAINABLE COMPOSITES – PART 1 OF 2:

Mahmoodul Haq
Michigan State University

Hybrid, Multi-Scale Reinforced Cotton Gin Waste-Based Composites

Cotton-gin waste (seed fiber) is a by-product of the cotton industry and is a renewable resource that is readily available in the U.S. Cotton-gin waste biocomposites have not been fully exploited due to limitations in fiber morphology, fiber-clumping, and inferior properties. In this work, improved surface preparation using AFEX (ammonia fiber expansion) and reinforcement of unsaturated polyester resin with nanoclay was performed to overcome some of these limitations. Additionally, hemp-fiber based composites also were studied for relative comparison. Preliminary results show that bio composites prepared using cotton-gin waste had comparable or better tensile strength vs. hemp fiber composites. Also, finite-element numerical models that realistically model and predict the thermo-mechanical properties of such hybrid composites were developed. Once experimentally validated, these models can be used as predictive design tools, eliminating the costly trial-and-error approach. Overall, the use of multi-scale (nanoclay + natural fiber) reinforcements with improved fiber-surface preparation show promise for use of such composites in a wide range of structural applications in automotive.

Ayse Ademuwagun
Hyundai-Kia America Technical Center, Inc.

Biobased Fillers for Polypropylene for Interior Application

Coconut shell and torrefied wood are bio-sourced and renewable materials that can be used as fillers in various polymer matrices. Torrefied wood can be produced from numerous cellulose-based materials, including wood, sunflower hulls, flax shive, hemp, and oat hulls. These bio-fillers would replace talc and glass bubbles, , which are not renewable resources. Additionally, use of torrefied wood and coconut husk would reduce the carbon footprint and improve the sustainability of Hyundai and Kia vehicles. In this study, coconut and torrefied wood filled polypropylene properties were tested for a heating/ventilation/air conditioning (HVAC) case application.

Esra Erbas Kiziltas
University of Maine-Orono

Preliminary Study of Using Heat Treated Wood in Engineering Thermoplastic Composites

Heat-treated wood-filled nylon 6 composites have higher mechanical properties compared to neat nylon 6. The rheological properties of the composites correlate with the crystallinity of wood fillers after the heat treatment. Wood fillers with high crystallinity after heat treatment contribute to a higher storage modulus and steady shear viscosity in the composites.

Abstracts of Speaker Presentations 2014

Wednesday Afternoon, September 10: KEYNOTE 1 In Diamond Ballroom

Jan-Anders Månson
Laboratory of Polymer and Composite Materials (LTC), École Polytechnique Fédérale de Lausanne (EPFL)

Why Sport is Important for Automotive Composites

With the performance margins between athletes becoming smaller and smaller, the involved equipment becomes increasingly important. This makes the sports market very competitive and an early adopter of new technologies. Composite materials are a main contributor to this very dynamic industrial environment, where the timeframe for adaptation and implementation of new technologies is challenged. Often new materials and devices will first be seen in the sports arena before they appear in other markets like aerospace and automotive. With new products and processes being so quickly developed, adopted, validated, and implemented, the survival rate of these products and processes is usually also fairly limited. New products and processes will very soon be replaced by the next generation. This turnover rate of the performance sports market is surpassed only by consumer electronics, which operates at an even faster pace. This complementarity in implementation dynamics provides great opportunities for efficient technology exchange, of mutual benefits for industrialization of new innovative technologies. Experts from other fields enter the stage, new ideas are formed, new shapes can be designed, new materials can be experimented with, etc. Sports can serve as a high profile test bed for new technologies in order to gather valuable experience across the borders.

Wednesday Afternoon, September 10: In Granite/Gold/Copper Room

ADVANCES IN THERMOSET COMPOSITES – PART 3 OF 3: Polyurethanes

Jean-Philippe(J.P.) Masson
Evonik Corp.

PU Prepregs – A New Approach to Highly Automated Composite Processing

Prepregs based on a novel blocked polyurethane matrix are stable at room temperature and offer improved performance characteristics. Unique handling properties allow the automation of composites manufacturing processes.

Troy Hendricks
Johnson Controls, Inc. (JCI)

Analysis and Reduction of VOCs in a Vehicle Interior: a Tier 1 Supplier Perspective

Over the last 10 years, the automotive industry began focusing on measuring and eliminating volatile organic compounds (VOCs) from vehicle interiors. This study measured the amount and types of VOCs emitted from thermoset headliners and investigated the effectiveness of different titanium dioxide nanoparticle coatings at eliminating VOCs from the vehicle interior. These results were then compared with the amount of VOCs emitted from the rest of a vehicle interior.

Peter Brookes
Huntsman Polyurethanes

A Tunable and Snap-Curing Polyurethane System Enabling Fast-Cycle Manufacture of Structural Composites

A novel "snap-curing" polyurethane (PU) resin is presented using the resin transfer molding (RTM) process for making automotive composite parts. The unique reaction profile reduces the overall cycle time, which thereby improves productivity. The composite resin demonstrates excellent physical properties, particularly tensile strength, tensile elongation-to-failure, and chemical resistance. When compared to other traditional composite matrix resins, the PU systems offer very-high toughness for a given glass transition temperature (T_g).

Kevin Roslinski
Henkel AG & Co. KGaA

High Volume Structural Composite Part Production: Paintable Parts Right out of the Mold through Surface Resin Transfer Molding Process

Driven by fuel efficiency targets, the automotive industry increasingly considers fiber-reinforced plastics as lightweight material options in modern car concepts. A novel polyurethane matrix resin enables high-speed composite fabrication. In cooperation with a major equipment supplier and several other composite expert companies, a new in-mold coating resin transfer molding (RTM) process has been developed to facilitate manufacturing of high-quality surfaces. This presentation outlines key processing and performance characteristics of the new polymer as well as the surface resin transfer molding process.

Wednesday Afternoon, September 10: In Emerald/Amethyst Room

ADVANCES IN THERMOPLASTIC COMPOSITES – PART 2 OF 2: Additives, Reinforcements, and New Polymers

Dana Swan
Arkema Inc.

ELIUM® - A Range of Novel Liquid Thermoplastic Resins for Composite Applications

A new range of liquid thermoplastic resins (LTP), marketed under the trade name Elium®, have been introduced for the production of thermoplastic composites reinforced by continuous glass, carbon, or natural fibers. The LTP, when combined with peroxide initiators, has the advantage of being processable using traditional thermoset resin techniques (e.g. resin transfer molding, infusion, flex-molding) and can be processed at both room and elevated temperatures. The final products have mechanical performances comparable to epoxy parts. However, they have the distinct advantages of being thermoformable, weldable, and recyclable (melt-reprocessable). Target applications include the automotive / transportation industries as well as wind power, athletic equipment, and the building sector.

Abstracts of Speaker Presentations 2014

Tamotsu Harada
Mitsui Chemicals America, Inc.

New Coupling Agent for Carbon Fiber Reinforced Polypropylene

Carbon fiber reinforced polypropylenes (CFR-PP) have received keen attention because they offer the lowest densities available for reinforcing fiber composites. The coupling agent between the polypropylene and the carbon fiber is one of the keys for achieving desirable mechanical properties of CFR-PP. It is well known that maleic-anhydride (MAH) grafted polypropylene can be applied as a coupling agent of CFR-PP. A new MAH-PP coupling agent has been developed. The properties of CFR-PP with this new coupling agent are described with comparisons to other compounds, such as glass fiber-reinforced nylon and polypropylene.

Akio Ohtani
Gifu University

Development of Thermoplastic Resin Impregnated Yarn and its Composite Properties

Continuous fiber-reinforced thermoplastic composites have become attractive material systems in recent years due to their recyclability and reduction in secondary processing. The fabrication of these materials involves two problems. The first is that thermoplastics, as matrices, generally have high melt viscosity, making it difficult to impregnate reinforcing fiber bundles with the resin. To overcome this problem, intermediate materials with carbon fiber and thermoplastic fiber have been developed. Since thermoplastic resin is located close to the reinforcement fiber bundle, impregnation performance of thermoplastics should be better. In this study, thermoplastic resin impregnated yarn was developed by using lower molecular weight resin as a intermediate material for continuous fiber reinforced thermoplastic composites. Several kinds of intermediate materials were fabricated by changing the content of resin and impregnation properties, and mechanical properties of unidirectional composites were investigated.

Gayle Tomkinson
Kraton Polymers LLC

Improving the Toughness of Unidirectional Thermoplastic Composites with Little Tradeoff in Flex Modulus

A novel styrenic block copolymer with extremely high melt flow has been shown to offer excellent glass fiber wet-out while providing outstanding impact resistance and energy absorption in polypropylene-(PP)-based composites. At several ratios in PP unidirectional glass fiber composites, there was a marked improvement in performance at room temperature and cold temperatures. Using this new resin as a modifier enables access to new applications and offers the ability to reduce wall thickness in existing applications.

Wednesday Afternoon, September 10: In Bronze/Silver Room

VIRTUAL PROTOTYPING & TESTING OF COMPOSITES – PART 3 OF 3: Testing & Manufacturing Corrections

Benjamin Hangs
Fraunhofer Institute for Chemical Technology

Evaluation of Process and Layup Induced Warpage for Tailored Laminates made from Thermoplastic UD-Tape
2010 SPE ACCE Scholarship Award Winner

This presentation deals with rectangular polyphenylene sulfide/carbon fiber (PPS/CF) laminates with a centered local reinforcement, orientated parallel to the long part edge. As an excerpt from a more extensive study, a selection of these laminates was investigated with regard to process and layup-induced shape distortions. For this purpose, finite-element modeling and laser scanning were applied to predict and evaluate part deformation.

Mathilde Chabin
ESI Group

Correction of Composite Parts Geometrical Distortions Induced by Manufacturing with Simulation

One of the biggest challenges for designers and manufacturers of composites parts is to ensure that designed parts can be produced within tolerance that will cause no issue at the assembly stage. This presentation focuses on automotive applications of composite materials for structural parts. It will first review adapted manufacturing processes for mass production and then describe the involved physics in resulting shape distortions. Computational techniques developed to predict manufacturing-induced residual stresses and shape distortion of composite parts made of continuous fibers and thermoset matrix will be presented, supported by an industrial example. Knowing how the part will distort after manufacturing is a first step. The second step consists of finding a solution to these geometrical defects in regards to the designed part. Simulation can then be of a great help in determining the proper process parameters and new mold geometry to reach tolerances. However this presentation intends to demonstrate that only the simulation of the complete manufacturing chain can validate a solution for distortions.

Sean Fowler
Q-Lab Corp.

New Accelerated Weathering Method for Automotive Coatings

After a decade of research, the newly published ASTM test standard, D7869, has been shown to provide excellent correlation to outdoor Florida test results for several failure mechanisms. This new method validates the idea that accelerated testing can accurately replicate outdoor weathering, but it also demonstrates that correlation to the natural environment is never a simple proposition. Although development of this standard focused on transportation coatings, there is significant interest in applying this method to plastic and composite materials used in the automotive industry.

Abstracts of Speaker Presentations 2014

Gary Latham
Pratt & Miller Engineering and Fabrication

Adhesive Applications in Motorsports: Design & Analysis Examples

Adhesive joining is used in many areas of race car construction and as such the design engineer must know how to design lightweight parts and join those parts together so they handle the loads just well enough not to fail. This presentation discusses various components that are commonly bonded together and some of the challenges faced in determining proper material properties. Test data show how important it is to understand the "as processed" material properties and then how those properties can be applied in structural analyses of more complex joints. The presentation concludes by looking at how additive manufacturing can be used to create low-volume, light, stiff structures.

Wednesday Afternoon, September 10: KEYNOTES 2 & 3 In Diamond Ballroom

Habib J. Dagher
University of Maine-Orono

Polymer Composite Materials in Infrastructure Applications

Composite materials have unique properties that allow them to deliver performance that competes with traditional materials in civil infrastructure, boat building, defense, and energy applications. This presentation will describe successful applications that employ the unique properties of polymer composites, such as the 'bridge in a backpack' technology, which combines composites and concrete; blast- and hurricane-resistant wood structures that combine wood and composites; the Mark V.1 high-speed interceptor for the U.S. Navy Seals, which takes advantage of the impact-absorbing properties of composites; smart hybrid composite shipping containers, which detect intrusions; and floating wind turbines, which take advantage of the lightweight properties of composite towers.

Kestutis (Stu) Sonta
General Motors Co.

Novel Composite Developments on the Chevrolet Spark Battery Enclosure

This presentation provides a quick overview of the development of a novel composite for a battery enclosure for an electric vehicle. Topics that will be covered include: defining requirements, materials and process selection, and implementation of a 7-ply biased-weave composite. This project worked with a completely new material formulation (a prepreg cloth-reinforced vinyl ester) that was subsequently molded in a conventional compression-molding process.

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Thursday Morning, September 11: In Granite/Gold/Copper Room

ENABLING TECHNOLOGIES – PART 2 OF 3: Compression Molding

Duane Emerson
Celanese

Development of a Doorframe Support Structure in Glass-Reinforced Polypropylene Composites: Material Validation & Process Enhancements

A study evaluated the use of unidirectional (UD)-glass-reinforced polypropylene tape-based composites in the production of a doorframe support structure for the storage-bin door of a commercial truck. Results of that work, including a process study, microscopy of the finished part, and a thermal study to optimize the process window, are reported here. The work for a semi-automated 4-step production process resulted in a lighter weight part, comparable in cost, and with reduced cycle time, showing potential to produce structural composite parts in 60 seconds or less.

Markus Geier & Thomas Joachim
Schuler Group

Large Scale Production Line with New Multi-Functional Hydraulic Short Stroke Press

The presentation will show the latest press technology with the ability to influence wall thickness of the part and the use of the latest tooling technologies for compression moulding. The new multi-functional hydraulic short-stroke press for processing fiber-reinforced composites can be used for both thermoset and thermoplastic composites. Data recording and a special analyzing tool are included in the press controls to guarantee highest quality for the parts and easy operation. With integration in an automated line for the production of, for example, carbon fiber-reinforced roof panels, large-scale production can be realized starting fully automated from carbon fiber textile to the cutter, pre-forming station, press, injection system, and ending with the waterjet cutter for final machining. The speakers will highlight the specific demands on each part of the process and will explain details for the key positions.

Thomas (T.J.) McDonough
Zoltek Corp.

Mechanical Study of Direct Long Fiber Thermoplastic Carbon / Polyamide 6 & its Relations to Processing Parameters

Direct long-fiber thermoplastic (D-LFT) manufacturing using glass fibers has been in use for many years and provides a stable platform for a variety of automotive parts. A joint effort between Zoltek Corp. and the Fraunhofer Project Centre at Western studied processing responses of compression-molded carbon fiber/polyamide 6 (PA6) D-LFT. This research mechanically quantified the effect of multiple manufacturing parameters for use in automotive semi-structural applications and aims to provide a better understanding of carbon/PA6 D-LFT mechanical properties.

Abstracts of Speaker Presentations 2014

Matthias Graf
DIEFFENBACHER GmbH Maschinen – und Anlagenbau

Tailored Fiber Placement LFT-D – Endless Fiber Reinforced Hybrid Composites – Flexible and Economical Process Technology for Structural Applications

Endless fiber-reinforced thermoplastic has many advantages compared to carbon fiber-reinforced plastic (CFRP) material based on thermoset resins. Carbon fiber-reinforced thermoplastics with higher grade polymers are achieving excellent properties. With the tailored fiber placement of direct long-fiber thermoplastics (LFT-D or D-LFT) technology, unidirectional-fiber-reinforced thermoplastic tapes can be used along the load passes and being co-molded together with LFT-D thermoplastics with discontinuous fibers. The process allows cost optimization and engineering the component to its application requirements.

(Break)

Thursday Morning, September 11: In Granite/Gold/Copper Room

ENABLING TECHNOLOGIES – PART 3 OF 3: Resin Transfer Molding (RTM)

Sebastian Schmidhuber
KraussMaffei Technologies GmbH

HP RTM Lightweight Composite Technologies – Machines and Processes

This presentation focuses on the various high pressure RTM (HP RTM) process variants, such as high pressure injection, open compression, wet molding, thermoplastic RTM, and the new Surface RTM process. Different process variations and possible resin concepts will be explained from the machine and process points of view. The presentation will conclude with an overview of the new Surface RTM process, which allows for a ready-to-paint high quality surface right out of the mold.

Klaus Ritter
Huntsman Advanced Materials

Compression Moulding vs. High-Pressure-RTM: Two Complementary Technologies for Cost Effective Carbon Composites Mass Production in Automotive

In this presentation, a compression moulding process based on newly developed epoxy resin systems is compared to high-pressure RTM for production of structural composite parts. It will be shown that a cure time of less than 1 minute, with a total cycle time of less than 1 minute 30 seconds is possible using optimized resin systems in an advanced compression moulding process. Such parts exhibit excellent part quality, with void content equivalent to RTM-processed parts, and display reaction conversion in excess of 95%, making post-curing unnecessary.

Tobias Jansen
Hennecke GmbH

High Pressure meets Lightweight

Apart from new drive concepts, reducing vehicle weight is an indispensable technique for ensuring more efficiency and a better energy balance in future automobile manufacture. In motor racing, lightweight construction has long provided for improved performance and less fuel consumption so that it has increasingly found its way into mass-production automobiles. In the car-body sector, automotive manufacturers meet these requirements by using fibre-reinforced structural components that are convincing both in terms of low weight and crash behaviour. Thanks to comprehensive investments, resin transfer moulding (RTM) now offers sufficient scope to potential customers as well as raw material partners to manufacture, test, and develop high-performance parts suitable for mass production. The composite specialists can score with an important further development of the RTM technology that ensures unlimited suitability for mass production in terms of automation and cycle time: the high-pressure RTM process (HP-RTM).

Philipp Rosenberg
Fraunhofer Institute for Chemical Technology

Effects of Process Parameters on Cavity Pressure and Component Performance in High-Pressure RTM Process Variants

This study addresses different variants of the high-pressure resin transfer molding (HP RTM) process, namely high-pressure injection RTM (HP IRTM) and high-pressure compression RTM (HP CRTM), for manufacturing high-performance continuous-fiber-reinforced composites. The work deals with understanding the effect of the most important process parameters on the cavity pressure profile for the selected process variants. Results provide a deeper understanding of the correlation between selected process parameters such as process variant, mold gap size, and maximum applied press force on the mold cavity pressure profile and resulting laminate properties.

Thursday Morning, September 11: In Emerald/Amethyst Room

TUTORIALS — PART 1 OF 2: LONG-FIBER THERMOPLASTICS (will be video recorded)

TRIPLE LENGTH PRESENTATION
Vanja Ugresic
Fraunhofer Project Centre @ Western

Tutorial on the Use of Long Fiber Thermoplastics in the Automotive Market - Parts 1 – 3

This 90-minute tutorial will cover the basics of injection molding and compression molding of long-fiber thermoplastic (LFT) components. It will also cover the use of inserts in the LFT matrix to improve mechanical properties of specific regions of the material. This concept is often called the multi-material concept for its ability to provide the specific part performance needed locally in the composite while maintaining overall cost and processing with existing LFT processes.

Tutorial is followed by LFT Round-Table Discussion

(Break)

Thursday Morning, September 11: In Emerald/Amethyst Room

TUTORIALS— PART 2 OF 2: NANOTECHNOLOGIES (will be video recorded)

DOUBLE LENGTH PRESENTATION

Alan Lesser
University of Massachusetts-Amherst

Engineering Nano-Reinforced Composite Materials - Parts 1 & 2

This tutorial reviews the basics in designing and engineering nanocomposite materials. First basic fundamentals relating how molecular and morphological structure relates to physical and mechanical properties of engineering thermoplastics are reviewed. Then aspects of reinforcement selection and design are discussed. Scale effects are covered as they relate to changes in both linear and nonlinear behavior. Challenges related to fabrication also are discussed, including reinforcement dispersion and interfacial adhesion.

Lawrence Drzal
Michigan State University

Graphene Nanoplatelets: A Multifunctional Nanomaterial Additive for Polymers and Composites

Graphene is the stiffest material found in nature having a modulus of over a TPa, with excellent in-plane electrical and thermal conductivity, excellent oxidation resistance, and a highly anisotropic platelet morphology. Particles consisting of a few layers of graphene (xGnP) can be inexpensively and efficiently produced in nanoplatelet morphology by a 'top-down' approach using common chemicals starting with mineralogical graphite. With the appropriate surface treatment, xGnP can be dispersed in polymers resulting in nanocomposites with superior mechanical, electrical, thermal, and barrier properties. xGnP also can be applied as a thin film or in coatings or fluids for applications where electromagnetic shielding, high electrical and thermal conductivity, or barrier performance are requirements as well. This tutorial will focus on the optimal use of this multifunctional graphene nanoplatelet particle, modifications to enhance its dispersion in thermoset and thermoplastic polymers, and processing methods to generate 2D and 3D microstructures. Examples of the range of multifunctional properties that can be obtained will also presented.

Tie Lan
Nanocor, LLC

Chemically Modified Bentonite Clays (Nanoclay) as Plastic Additives-Applications in Automotives

Chemically modified bentonite clays have been developed as plastic additives in the last 2 decades. The dispersion and distribution of these 1-nanometer-thick layered silicate layers into plastic resin created a new class of composite materials: nanocomposites This tutorial will focus on the clay surface modification chemistry, processing of these organoclays into plastic resins, and unique properties of the nanocomposite materials, such as mechanical reinforcement, enhanced barrier, and increased flame retardancy. Particularly, some commercial applications such as light-weight injection-molded parts will be presented. New development in the use of nanocomposites in fuel line and new panels will be discussed, whereas the functionality of the nanocomposite outweighs the cost difference vs. traditional fillers.

Thursday Morning, September 11: In Bronze/Silver Room

ADVANCES IN REINFORCEMENT TECHNOLOGIES – PART 1 OF 2: Carbon and Honeycomb

Tommy Fristedt
Laystitch LLC

Tailored Fiber Placement - Modular Design and Additive Manufacturing

Fiber orientation can be optimized to reinforce local areas of a composite part, enabling high-performance solutions to be realized. Taking a modular design approach to reinforcement improves efficiency and design through-put. Design topology and fiber distribution in pre-developed preform building blocks, fiber orientation, and fiber placement/distribution within the part will be discussed for improved part performance. Various application examples and preform designs will be presented along with resulting benefits.

Frédéric Vautard
Michigan State University

Engineering the Carbon Fiber-Vinyl Ester Interface for Improved Mechanical Properties

Carbon fiber-vinyl ester composites currently attract some interest for the production of high-volume, low-cost carbon fiber parts for the automotive industry. Nevertheless, the mechanical properties of carbon fiber-vinyl ester composites do not match the properties of carbon fiber-epoxy composites, essentially because of low levels of interfacial adhesion. In this study, an analysis of the phenomena at the origin of this low interfacial adhesion will be given, and promising results regarding the development of reactive coatings leading to high levels of interfacial adhesion and mechanical properties equivalent to epoxy-based systems will be reported.

Klaus Gleich
Johns Manville Technical Center

A New Generation of Thermoplastic Honeycomb based on Polyester Spunbond

Honeycombs based on polyester Spunbond offer high temperature resistance and excellent adhesion to a variety of gluing systems and foams due to their porous structure, thermoformability, and offer excellent ageing performance. This presentation will focus on the Spunbond process and the specifics of the honeycomb that can be made from this material.

(Break)

Abstracts of Speaker Presentations 2014

Thursday Morning, September 11: In Bronze/Silver Room

ADVANCES IN REINFORCEMENT TECHNOLOGIES – PART 2 OF 2: Glass & Basalt

Ryan Emerson
PPG Industries

High Rate Response of Novel Fiberglass for Automotive Composites

Due to their high specific strength and stiffness properties, low cost, and global availability, glass fiber-reinforced plastics continue to be attractive materials for various automotive applications. While usually limited to injection molded parts and sub-assemblies in underhood and secondary load-bearing structures, their potential for body-in-white and primary structures is yet to be tapped by major auto OEMs. Difficulties with high volume production processes and handling of continuous reinforcements have so far kept the use of these materials out of high-volume vehicle platforms. However, recent developments with high pressure RTM processes and reactive thermoplastics, coupled with the global need to reduce greenhouse gas emissions and increase fuel economy as a response to environmental regulations have opened the door to these materials to new and more demanding applications. In this presentation, the high strain-rate tensile response of unidirectional fiber glass/epoxy composites will be examined. Composite laminates with novel high modulus and high elongation glass compositions and state-of-the-art sizing technology are the focus of this investigation. Traditional E-glass / epoxy composite will serve as a baseline material.

Corey Melvin
Owens Corning

Long Fiber Thermoplastic Polypropylene Reinforced with Novel Glass Reinforcements Offers Innovative Potential in Comparison to State-of-the-Art

Growth of glass fiber-reinforced long fiber thermoplastics (LFT) has been and will remain high (>10%) for the foreseeable future driven primarily by the need for lightweighting in the automotive and transportation markets. Initially considered a commodity, polypropylene (PP) is now ranked as one of the most versatile resins able to compete with and replace engineering plastics and traditional materials such as steel and aluminum in these markets. A new glass fiber reinforcement with advanced organic coating chemistry (sizing) provides superior glass processing, wet-out / dispersion and PP compatibility, enabling up to a 40% increase in traditional LFT compounding line speeds. This newly developed glass fiber also enables higher glass loadings, paving the way for new applications requiring greater performance is currently achievable in this material. This presentation discusses how the new premier glass reinforcement helps not only to meet short-term demand for LFT PP by increasing production capacity of existing compounding assets, but also helps promote long-term growth in demand for LFT PP by providing a new level of end-use performance through higher glass loadings and improved glass-PP matrix bond strength.

Ting Yang
Kyoto Institute of Technology

Polyurethane Surface Treatment of Two Kinds of Basalt

Basalt fiber is a kind of fiber that has excellent mechanical properties and outstanding chemistry stability. Its cost is much lower than carbon fiber, but mechanical properties approach those for carbon fiber. This presentation will focus on a new kind of surface treatment for basalt fiber.

Thursday Afternoon, September 11: KEYNOTES 4 & 5 In Diamond Ballroom

Daniel Ageda
JEC Composites Group

Overview & Dynamism of the Wordwide Composites Market

Emerging opportunities from fast-growing markets and dynamic regions will confirm the double-digit growth rates forecast for the composites industry.The key drivers in the composites industry are ever challenging in terms of lightweight reduction of raw materials and manufacturing costs; production with higher quality standards; and sustainability in eco-friendly environments. To meet expectations, several technological developments are focused on integrated design solutions, testing and analysis, life-cycle assessment, and composites process productivity to face large-scale production. The main growth leverages will come from the: large consumption due to human-population increases and its needs with no limits; numerous innovations that feed the market and boost the use of composites instead of other traditional materials; and technology transfers from the academic to the industrial world. The key focus covered in this talk will be the dynamics of different markets; trends and innovations; key application sectors; and technology flow from academic research to industrialization.

Matthew Marks
American Chemistry Council

Plastics and Polymer Composites Technology Roadmap for Automotive Markets

Under the direction of the American Chemistry Council (ACC) the automotive and polymer materials industries worked together to create a new strategic framework for collaborative progress. The *Plastics and Polymer Composites Technology Roadmap for Automotive Markets* is designed to help the automotive and plastics and composites industries maintain a strong foundation upon which to build partnerships that address changing market needs.