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THERMOSET TOPCON
Madison, Wisconsin • April 30-May 1, 2024
Presented by SPE Thermoset Division

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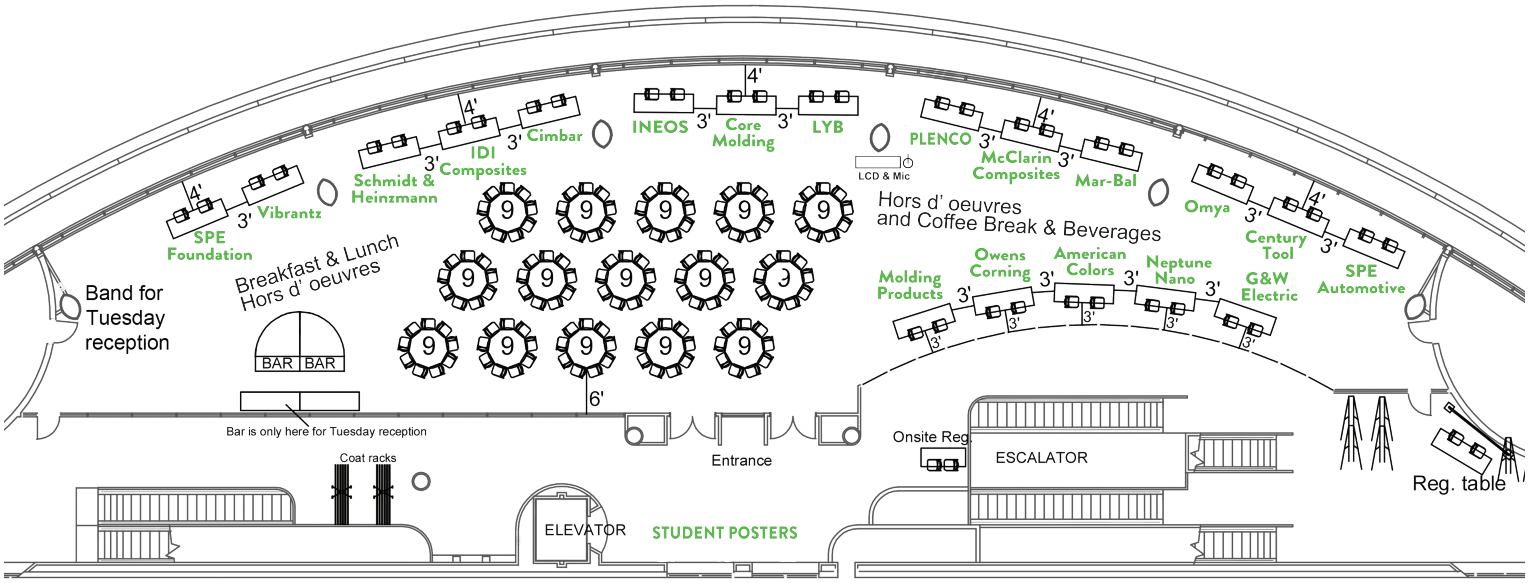

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Presented by SPE Thermoset Division

SEAN CAMPBELL
Division Chair
LyondellBasell

Welcome OEMs, Resin Suppliers, Compounders, Molders, Professors and Students to the **2024 SPE THERMOSET TOPCON CONFERENCE** on the beautiful shores of Lake Monona in Madison, Wisconsin. The 2024 Conference is being held in the same location as last year and this will also be the location for the 2025 event.

The Theme this year is **"Reinforcing Industry"** and is meant to show that TOPCON is focused on real, industrial issues. TOPCON delivers technical papers about Thermoset Chemistries and how they are used in an Industrial Setting. The TOPCON Conference attempts to deliver this cutting edge technology with an eye on how these materials can be used in Industry for today and for tomorrow.

Our Keynote will be delivered by **Marcy Offner** talking about ***"Women in the Composites Market"*** and nearly one third of our papers are on the topic of **Sustainability, Recyclability and the Reuse of the Thermoset Materials.** Both of these topics derived from questions raised by attendees during our Business Leadership Forum at the 2023 TOPCON Meeting.

The SPE Thermoset TOPCON Conference takes place on Tuesday April 30th and Wednesday May 1st in beautiful Madison, Wisconsin. The Conference is set up to merge world class technical presentations with ample time for networking and informal business discussions.

Enjoy the talks and the comradery of the participants in the industry. The Thermoset Industry is a big enough Industry where true breakthroughs can happen and small enough that everyone can make a difference in improving this Industry.

Looking forward to seeing everyone again this year.

Thank you,
Sean Campbell
LyondellBasell Sales and Marketing Manager
Chair 2023-2025 SPE Thermoset TOPCON

WELCOME

ALL TIMES CT
(Central Time)

TUESDAY, APRIL 30, 2024

7:00–8:00 **NETWORKING BREAKFAST** *Sponsored by* Composites International idicomposites.com **& EXHIBITS**

8:10–8:20 **OPENING OF THE 2024 TOPCON SHOW: Len Nunnery,** *Board Member* TOPCON - *PLENCO*

DAY 1 AM MODERATOR: Sean Campbell, *Chair* TOPCON - *LyondellBasell*

8:30–9:15 **KEYNOTE ADDRESS:** **EMPOWERING WOMEN IN COMPOSITES: BUILDING BRIDGES AND STRENGTHENING THE INDUSTRY**
Marcy Offner, ***Composites One & Women in the Composites Industry (WCI)*** \

BIO: **MARCY OFFNER** has worked in the composites and advanced materials industry for more than 20 years. Serving most recently as Director of Marketing Communications, at Composites One, she was instrumental in the development of the Composites One brand. She also played a critical role in the Composites One technical support program - including producing joint technical workshops with IACMI and live process demonstrations. Since her tenure began, she has served on various ACMA committees from the Technical, Marketing, and the CAMX Steering Committee. She served as Chairperson of CAMX several times. She is a past ACMA Volunteer of the Year award winner and in 2022 she received the prestigious ACMA Chairman's Award for her contributions to ACMA, CAMX and the composites industry. She is also the founder of Women in the Composites Industry. When asked what she loves most about the composites and advanced materials industry, she says "It's simple - the people are the best - they work hard, want to make their customers happy and are filled with innovative ideas."

ABSTRACT: The participation of women in the global composites and advanced materials industry is on the rise. As this sector expands, women are dismantling obstacles, fostering mentorship, and harnessing their collective power. Building a supportive community is essential not just for women but also for forging strong collaborations with our male counterparts. By cultivating a cooperative atmosphere, we can close existing divides and fortify our industry. Marcy Offner will share insights, valuable experiences, and tactics to capitalize on the distinctive contributions of women within the composites sector.

9:15–9:45 **FEATURED PRESENTATION:** **UNIVERSITY OF WISCONSIN - MADISON SAE RACING TEAM VEHICLES MADE WITH THERMOSET TECHNOLOGY**
Lily Zahn & Jackson Talbert, ***UW-Madison***

ABSTRACT: We are Wisconsin Racing. We are students from UW Madison that build ⅓-scale Formula 1 cars to compete in an international collegiate competition, Formula SAE. The competition is composed of several 'dynamic' racing events such as an autocross and endurance race, and a few 'static' events, including a design competition. Each year our team builds two new cars, one combustion and one electric.

A point of pride on our team is our range of manufacturing capabilities, including our work with carbon-fiber reinforced epoxy structures. We cover a range of composites processes using both oven-cured prepreg and RTM. We use several types of tooling, including machined and sealed tooling foam, wet-lay carbon-fiber epoxy, and 3D-printed PC-ABS molds.

We use these processes to produce carbon fiber monocoques- the primary structure of the cars- as well as aerodynamic elements for the cars. In our presentation, we will go more in-depth into the thermoset processes we use on the team and how we manufacture our race cars.

BIO: **LILY ZAHN,** Lily is the Aerodynamics and Composites team lead and oversees the design and manufacturing of the aerodynamics packages. She is in her 3rd year at UW Madison pursuing Biomedical Engineering.

BIO: **JACKSON TALBERT,** Jackson is the Structures team lead at Wisconsin Racing and oversees the design and manufacturing of two CFRP chassis. He is in his 3rd year at UW Madison pursuing aerospace engineering.

BIOS/ABSTRACTS

9:45-10:15 **NETWORKING BREAK & EXHIBITS**

10:15–10:45 **PROCESS TECHNOLOGY: Cutting & Stacking Redesigned AutoCut Pick & Place**
Christian Fais, ***Schmidt & Heinzmann***

BIO: Christian Fais has held his position as President of Schmidt & Heinzmann North America since July 2018, where he is responsible for business development,sales, and technical support in North/South America. Christian has more than 20 years of experience in Technical Sales and Project Management and held several positions in the plant engineering and construction business. During the start-up phase of the Fraunhofer Project Center in London, ON he was responsible for implementing and setting up the LFT-D, D-SMC and RTM process in cooperation with the Fraunhofer selected researchers. In his current primary role, he is responsible for the business growth of the company Schmidt & Heinzmann North America Inc and runs both operations located in Chandler, AZ and Akron, OH.

ABSTRACT: The presentation will outline the redesigned AutoCut Pick&Place technology for slitting SMC or dry fiber fabrics more efficiently. The new solution combines several process steps and reduces the foot print. This technology is setting new standards in the SMC slitting process.

The technology brings the following benefits:

1. Faster handling process
2. Easier Installation and quicker start-up
3. Reduces foot print

10:45–11:15 **MATERIAL TECHNOLOGY: High-Performance Thermosetting Resin**
Henry Sodano, ***Trimer Technologies***

BIO: Dr. Sodano is the CEO and Founder of Trimer Technologies which develops high performance polymers to enable low cycle time manufacturing of high-performance composites. He received his Ph.D. in Mechanical Engineering from Virginia Tech in 2005, his M.S. in 2003 and his B.S in 2002 also from Virginia Tech. He has published over 291 technical and made over 175 national and international presentations with over 20,500 citations of his work. He received the 2012 American Society of Composites Young Researcher Award, was selected as Virginia Tech's Outstanding Alumni, has received numerous best paper awards and is a Fellow of AIAA and SPIE and an Associate Fellow of AIAA.

ABSTRACT: Trimer Technologies has developed a high-performance thermosetting resin that provides cure times as fast as 30 seconds while achieving the mechanical properties of 350 F (177 C) cured aerospace epoxies and a Tg greater than 700F. Although the resin exhibits a fast cure, it offers a long gel time to enable infusion of large components and greatly exceeds FAA fire resistance standards for aircraft interiors. Trimer has developed thermosetting resins for bath or injection pultrusion, RTM and VARTM as well as latent system for SMC/BMC processing all of which enable the lowest cycle time of any high performance thermoset while providing industry leading FST, Thermal and Mechanical properties at an automotive price point. This presentation will describe the unique processing and material properties offered by Trimer's Rapid resin system.

11:15–11:45 **SUSTAINABILITY: Understanding the Carbon Footprint of Sheet Molding Compounds**
Eric Haiss, ***IDI Composites International***

BIO: Eric Haiss is the Global Director for Automotive Business Development at IDI Composites International and Norplex where he is focused on building relationships with major Tier 1 and OEM customers. Eric joined IDI in 2020, and is a member of IDI's Technical Steering Committee, and Champion for IDI's sustainability initiatives.

Prior to joining IDI, Eric worked in a variety of engineering and business development roles within automotive and adjacent markets, with the past 15 years focused on composite applications. Eric has Master of Science in Administration from Central Michigan University, a Bachelor of Science in Mechanical Engineering from Kettering University, and is a Six Sigma Green Belt.

ABSTRACT: As customers face increased pressure to reduce the carbon footprint of the materials and products they use, it is important to understand how various materials and processes compare. This presentation will review IDI Composites International's efforts to understand the Global Warming Potential (GWP) of thermoset SMC's, including a review of Life Cycle Assessment (LCA) data for select SMCs and how they compare to other engineering materials.

11:45–12:15 **MATERIAL TECHNOLOGY: High End Properties of Polyesters**
Adam Tomasik, *LyondellBasell*

BIO: Adam C. Tomasik holds a PhD in Chemistry from the University of Wisconsin-Madison (2008). He has previously worked in the silicones industry with a specialization in resin synthesis and multi-functional cure systems. Since July 2023, he has been part of LYB and is closely aligned with the Quantum-ESC product line.

ABSTRACT: Quantum Composites by LyondellBasell offers a revolutionary product line which has redefined traditional material applications across multiple industries. In this presentation, we delve into why Quantum materials stand out, showcasing their unparalleled capabilities compared to conventional SMC or BMC materials. In aerospace, Quantum products deliver lightweight solutions coupled with exceptional stiffness, strength, and flame retardancy, revolutionizing aircraft design and performance. Similarly, in the oil and gas sector, Quantum excels in high-temperature environments, offering unmatched stiffness and strength properties, enhancing operational durability and reliability. Through this overview, we explore how Quantum Composites propel innovation, setting new standards in material science and engineering across diverse industries.

12:15–1:15 **NETWORKING LUNCHEON** *Sponsored by* MBI MAR-BAL INCORPORATED **& EXHIBITS**

DAY 1 PM MODERATOR: Len Nunnery, *Board Member* **TOPCON -** *PLENCO*

1:15–1:45 **TESTING TECHNOLOGY: Ultrasound Inspection, Geometric Characterization of Damage, and Final Part Performance Prediction Methodology for Laminated Composites with Drilled Holes**
Dr. David Jack & Kirtunia Rahul, *Baylor University*

BIO: Dr. David Jack holds five degrees in Physics, Mathematics and Mechanical Engineering. David has been awarded $16,500,000 in sponsored research, of which he is lead PI on $12,900,000. He has published over 40 journal articles, over 100 national and international conference articles, twelve patents, and thirteen patents pending. David has established himself as a leader in numerical modeling and inspection of fiber reinforced polymer systems spanning composite railroad ties, aerospace primary structure, automotive components, and sporting goods. The techniques developed by Dr. Jack and his students have resulted in fifteen different FAA 8100-9 Statement of Compliance with Airworthiness Standards.

BIO: Kirtunia Rahul has received his B.Sc. in Engineering in Naval Architecture and Marine Engineering from Bangladesh University of Engineering and Technology. After working several years as Assistant Naval Architect and later as Territory Manager in Industrial Coatings, he joined Baylor University to pursue Ph.D. in Mechanical Engineering under the supervision of Dr. David Jack. Along the way, he also received his master's in mechanical engineering from Baylor University. His research area is focused on the damage assessment using Non-Destructive Testing (Ultrasound) and implementing Ultrasound information for generating predicting models of composite materials through Finite Element Analysis. He has published several peer reviewed journal papers, conference papers, and presented posters at different conferences. He hails from Mymensingh, Bangladesh.

ABSTRACT: The use of carbon fiber reinforced materials have become mainstream in the aerospace, automotive, and sporting industries due to their versatility, performance, and high strength to weight ratio. Thermoset composite structures are often joined using various fasteners when adhesives are not sufficient or possible due to manufacturing considerations. The use of a fastener requires the drilling of a hole within the laminate, often causing delaminations surrounding the hole. These delaminations are both difficult to detect and reduce the operational allowable loads. This work presents a novel method to nondestructively characterize the damage induced by drilling within a laminated composite and incorporates the ultrasonically characterized damage zone into the finite element model to estimate the part performance. The inspection is performed using high-frequency ultrasound to create a three-dimensional image of the delamination zone, and results are compared to those from micro-X-ray computed tomography and are in excellent agreement. The characterized three-dimensional damage zone is then incorporated into a finite element model domain, and using cohesive zone damage progression simulations the damage profile under tensile testing is captured. The finite element results for the strain field are then compared to physical test results of the strain field during loading from digital image correlation. The novelty of the presented method is the combination of physical testing, non-destructive testing for the geometric extraction, to structural predictions using the inspection data directly.

1:45–2:15 **TESTING TECHNOLOGY: Ultrasonic Waveform Tracking and Testing of Mechanical Properties of Carbon Fiber Laminate Internal Ply Drops**

Dr. David Jack & Joshua Norlin, *Baylor University*

BIO: Joshua Norlin is currently pursuing his Ph.D. in Mechanical Engineering with the assistance of his advisor, Dr. David Jack at Baylor University. Previous to his time at Baylor, he worked for two years as a contract engineer at Caterpillar Inc. in the Peoria area of Illinois. He has earned both his B.S. and M.S. degrees in Mechanical Engineering at Washington University in St Louis, along with a minor in music (vocal performance). His current research area is focused on location and characterization of ply drops in CFRP laminates using non-destructive testing techniques (ultrasound). He has presented posters and attended conferences for SPE before, such as the Polyolefins conference in Texas and the ACCE conference in Michigan. He is currently the vice president of the Baylor University SPE student chapter.

ABSTRACT: Ultrasonic Testing is a common nondestructive method of locating defects and irregularities in composite laminates. Ply drops are often encountered in the industry, sometimes as a manufacturing induced defect and sometimes as a result of a designed change in thickness. The goal of this work is to present a non-destructive technique using ultrasonic waveform analysis to track the dropped layers across the part as well as to show how ply drops affect mechanical properties of the laminate. Multiple parts were manufactured with different types of ply drops, such as a square pattern in the center of the part, a multilayer taper, a sinusoidal curve across the center and a gap representing the end of a roll of carbon fiber and the start of a new one. A code is developed in the MATLAB environment to track the drops through the panel and to give an estimate of the particular layer location. The developed algorithm is able to successfully capture each individual ply. Samples of each type of part were taken for mechanical testing to show how the mechanical properties of the laminates were affected. These results show that the layers that drop can be clearly seen and identified even with nonsymmetric patterns.

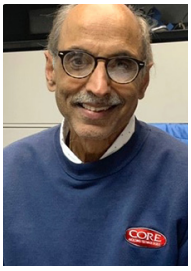
2:15–2:45 **TESTING TECHNOLOGY: Fire Retardant Chemistries, Mechanisms, Small Scale Burn Test for Thermosets**

Glade Squires, *Omya* & Vinod Arora, *Core Molding Technologies*

BIO: **GLADE SQUIRES** holds an Undergraduate and graduate study in Chemistry University of Pittsburgh and has over 40 years' experience in the Flame Retardant industry. Mr. Squires has held positions in Flame Retardant synthesis in R&D, Commercial Development, Sales and Marketing, and has experience in all Flame Retardant chemistries.

Further professional titles for Mr. Squires include Former Vice President of the Fire Retardant Chemicals Association and Former board member of the Massachusetts Chemistry and Technology Alliance.

On a personal level, Mr. Squires contributions include: Former President and Commissioner of the Pennsylvania Fish & Boat Commission; President of the West Chester Fish, Game & Wildlife Association; as well as Hunter Safety Instructor Pennsylvania Game Commission.



BIO: **VINOD ARORA** is Director of Materials and Technology with Core Molding Technologies, a custom molder and processor of engineered composites headquartered in Columbus, Ohio. Prior to Core, Vinod has worked with other custom processors in similar industries and also in the paper and rubber industry. `He has a BS and MS in Chemical Engineering. Mr. Arora has been with Core Molding for 15 years and has more than 30 years of professional experience in materials, design, processing and manufacturing including compression, transfer and injection molding. `He resides in Spartanburg, SC with his wife, has 4 grandchildren, enjoys tennis and teaches Yoga and Pranayam.

ABSTRACT: There are a wide range of flame retardants available but only a few will meet the desired properties and economics required by thermoset materials. Depending on the end use of a thermoset part, a very specific and sometimes expensive burn test is required. However, there are several small scale burn tests that can be used to help guide product development toward meeting the more stringent burn tests.

Reviewed will be the various flame retardant chemistries, mechanisms, small scale burn tests and some applications of flame retardant thermosets including challenges in EV battery applications.

2:45–3:15 **NETWORKING BREAK & EXHIBITS**

3:15–3:45 **SUSTAINABILITY:** **A Roadmap to More Sustainable Composite Materials**
Mike Siwajek, *Teijin Automotive Technologies*

BIO: Mike Siwajek, Ph.D., is Vice President of R&D at Teijin Automotive Technologies. He is in his 25th year in the composites industry, starting as a formulations chemist at the Budd Company in December 1999 and remaining with that entity through its transition to Continental Structural Plastics (CSP) and to the company now known as Teijin Automotive Technologies. Mike was named Vice President of R&D shortly after Teijin's acquisition of CSP in January of 2017 and remains in that role today. Mike was also honored to be appointed as a Teijin Group Senior Technical Expert in January of 2018. Mike's team's contributions to the science of thermoset composites have helped Teijin Automotive Technologies become a world leader in providing composite solutions to the global automotive industry. Mike is a proud alum of both Kalamazoo College (BA-Chemistry, 1992) and Purdue University (Ph.D.-Synthetic Organometallic Chemistry, 1999).

ABSTRACT: While there is an increasing demand for more sustainable materials from automotive and consumer markets, the targets are often soft, and requirements loosely defined. This situation makes an already challenging task even more difficult. Teijin Automotive Technologies (TAT) is taking a holistic approach to improve the sustainability of composite materials. TAT is committed to playing an active role in the industry's long-term goal of net zero CO2 emissions and reducing the overall environmental impact of vehicle manufacturing. TAT's lightweight composite solutions already help lower emissions and fossil fuel consumption for ICE vehicles. Additionally, TAT has supplied protective battery enclosures for more than a decade to multiple OEM customers supporting their electric vehicle platforms. Beyond optimizing and implementing current technologies, TAT has expanded efforts to consider Life Cycle Assessment (LCA), sustainable raw material inputs, low VOC composites, utilization of scrap and end-of-life components, as well as reduction of the company's carbon footprint. As customer requirements become more concrete, these efforts combined with those of TAT suppliers and industry partners should assure that composite materials are viable well into the future.

3:45–4:15 **PROCESS TECHNOLOGY:** **Reducing Air Trap and Weld Lines While Ensuring Uniform Heating While Molding BMC Materials**
Ryan Furno, *Sigmasoft*

BIO: Ryan Furno is a Graduate from Ferris State University with a B.S. in Rubber Engineering and A.A.S. Plastics Technology. He worked in the rubber industry as a Sr. Materials Engineer for 15 years with a concentration of rubber testing, rubber mixing and rubber to metal bonding.

ABSTRACT: Air trap and weld lines are some of the major scrap modes when molding BMC compounds. My presentation will focus on how to decrease these scrap modes using compression molding. Consistent heat throughout the mold is important while molding BMC compounds. I will demonstrate how to achieve this during my presentation.

4:15–4:45 **MATERIAL TECHNOLOGY:** **Coupling Agents: Additives for Enhancing Mechanical Properties of Thermoset Composites**
Brian Kleinheinz, *BYK USA*

BIO: Brian Kleinheinz is the Technical Service Manager for Thermosets at BYK USA. In this role, he assists composite manufacturers with BYK additives that improve the performance and processing of epoxies, vinyl esters, unsaturated polyesters and polyurethanes. Previously, he worked at Polynt Composites, developing vinyl ester and unsaturated polyester formulations for the transportation, marine, energy and construction composite markets. Brian received a BS in Chemical Engineering from the University of Wisconsin-Madison and has spent nearly 20 years in the composites industry.

ABSTRACT: Thermoset composites are chosen for many applications because of their excellent mechanical properties. These mechanical properties derive both from the thermoset matrix, or resin, and from the particular reinforcement, whether glass, carbon, or filler. In designing composite parts, the mechanical properties of the finished part can be improved by selection of stronger individual components – a higher strength resin, or a stronger reinforcement fiber perhaps. But there is a limitation. In many composite applications, failure of the part occurs at the interface between the resin and the reinforcement, and thus the ultimate achievable strength of a given system is dependent on this interface. In this paper, we present a method for increasing the strength of the bond between resin and reinforcement through the use of the BYK-C 8000 line of "coupling agents". These easy-to-use agents are liquid additives that form a chemical bond between the resin and the reinforcement during the curing process, strengthening the interface between resin and reinforcement and resulting in significantly improved mechanical properties. We will review the basic theory and structure of these coupling agents and describe their usage. Furthermore, we will examine three case-studies where coupling agents were used, giving enhanced mechanical properties, compensating for storage related decomposition of fiber-sizing and ultimately giving much more freedom in design of composite parts.

4:45–5:00 **DAY 1 CLOSING REMARKS Sean Campbell, Chair TOPCON - *LyondellBasell***

5:00–7:00 **COCKTAIL RECEPTION** *Sponsored by* plenco **& EXHIBITS**

7:00 **CONFERENCE ADJOURNS FOR THE DAY**

BIOS/ABSTRACTS

ALL TIMES CT
(Central Time)

WEDNESDAY, MAY 1, 2024

7:00–8:00 **NETWORKING BREAKFAST** *Sponsored by* lyondellbasell *Advancing Possible* **& EXHIBITS**

DAY 2 AM MODERATOR: Greg Spaeth, *Board Member* TOPCON – *PLENCO*

8:00–8:30 **SUSTAINABILITY:** **Towards More Sustainable Resins**

Jonathon McKay, *INEOS Composites*

BIO: Jonathan McKay received his bachelor's degree in chemistry from Northwestern University and his Ph.D. in organic chemistry from the University of Illinois. He began his industrial career for Hercules, Inc., developing water soluble polymers for use in the pulp and paper industry. Since 2013 he has worked for INEOS Composites (formerly Ashland) in their product development group, spending the majority of that time devoted to the development of novel unsaturated polyester and vinylester resins and formulating them for transportation applications, including weatherable mold-in-color SMC, low density structural SMC, and styrene-free prepreg resins.

ABSTRACT: The thermoset composites industry has gone to great lengths highlighting ways in which their products can potentially reduce a consumer's environmental and economic footprint. For instance, the use of thermoset composites in automotive applications frequently increases fuel efficiency in the vehicle. In another example, the use of thermoset composites in building and infrastructure can result in products with extended lifespans, thus reducing waste and unnecessary consumption of fossil fuels.

In this presentation, INEOS Composites will illustrate advancements in creating thermoset composite resins that are themselves more sustainable, and outline plans to increase their use. Examples will include:

- The expanded use of sustainable and renewable bio-based feedstocks in unsaturated polyester resins (UPR), resulting in sheet molding compound (SMC) with reduced fossil fuel requirements
- The accelerated integration of recycled thermoplastics in UPR and low-profile additives, thereby enhancing the sustainability of the raw material supply chain
- The use of life cycle analysis (LCA) to highlight opportunities for reduced energy consumption in the production of thermoset materials
- The identification of prospects for the potential recovery, re-use, or recycling of thermoset composites

Discussion will also include the identification of current obstacles and opportunities for collaboration amongst raw material suppliers, tier-1 part suppliers, OEMs, industry organizations, and academia to create a more sustainable industry.

8:30–9:00 **SUSTAINABILITY:** **Case Studies Showing Benefits of Thermosets for Environment & Reclaimed Recycling**

Greg Spaeth, *PLENCO*

BIO: Greg Spaeth is Project Engineer at Plastics Engineering Company (PLENCO). PLENCO is headquartered in Sheboygan, WI and is a leading North American manufacturer of phenolic resins and thermoset molding materials. Mr. Spaeth holds a BS in Mechanical Engineering.` He carries out special research and development projects, including material development and specific part functionality testing. With the PLENCO Technical Service Department, he works with customers to prototype new tooling and cut costs through process improvement projects. His work now includes providing part optimization and design input utilizing PLENCO's Finite Element Anaylysis capabilities.

ABSTRACT: When discussing or advertising recycling, carbon footprint, green manufacturing, etc. there can be a great deal of uncertainty. Vagueness is common, with many terms being applied in disparate ways. The ISO 14000 family of environmental management standards provides suggestions regarding the terminologies and contexts within which organizations should report / advertise their endeavors.

This presentation will briefly analyze the terms utilized to establish an Environmental Management System (EMS). Statistics regarding plastic recycling will be highlighted along with actual case studies concerning successful and unsuccessful so-called "green initiatives". This work will conclude with examples of projects the thermoset industry has executed in pursuit of "green manufacturing" (specifically, strategies implemented by Plastics Engineering Company).

9:00–9:30 **SUSTAINABILITY:** **Biodegradable Chitin Nanowhisker Reinforcement In Epoxy: A Themal and Mechanical Property Analysis**

Aaron Guan, *Neptune Nanotechnologies & Lampton College Ontario*

BIO: Aaron Guan is recognized as one of the most innovative young serial entrepreneurs (Forbes 30 Under 30) and one of the most influential people under 35 in the plastics industry (Rising Star 2015 by Plastics News), Aaron Guan is the Founder and CEO of Neptune Nanotechnologies Inc. He also serves as Board Director and Newsletter Chair for the Society of Plastic Engineers' Thermoplastic Materials and Foams Division.

Mr. Guan received both his B.A.Sc and M.A.Sc in mechanical engineering at the University of Toronto, he has a number of patents and publications in the fields of bio-based nano-reinforcement, biopolymers, thermoplastics, and composites. Decorated with multiple awards recognizing his efforts in the development of sustainable biobased nanotechnology and entrepreneurship, Aaron founded Neptune in 2022 which specializes in the development of a novel nano-material known as chitin nanocrystal, a fishing waste-sourced single crystal with a wide range of applications.

ABSTRACT: Nano-sized fillers are widely used additives to enhance the properties of polymers. Transitioning from micro- to nano-fillers leads to superior reinforcement in nanocomposites, requiring significantly less filler material compared to their conventionally sized counterparts. Among these nanofillers, chitin, a naturally abundant and biodegradable polymer, stands out due to its lack of toxicity and impressive mechanical properties compared to other synthetic options. In this study, we explore the potential of chitin nanowhiskers (CNWs) to improve the thermal and mechanical properties of various grades of epoxy, a commonly used thermosetting polymer.

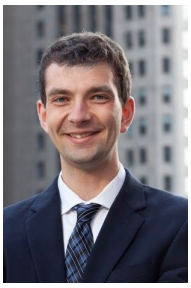
We incorporated CNWs into the epoxy matrix at varying weight percentages (0 to 1 wt%) and characterized the resulting nanocomposites using various experimental techniques. Our findings revealed that there is no difference in thermal stability of nanocomposites with the addition of CNWs. Gradual improvement in mechanical properties also observed with increasing CNW content, reaching an optimum at 0.25 wt%. This optimum loading showcased the best mechanical properties such as tensile and impact strength increased to 2.5-fold and 2-fold respectively, while exceeding 1 wt% presented challenge in achieving uniform CNW dispersion, resulting in low mechanical performance of the nanocomposites.

This study demonstrates the promise of CNWs as a sustainable and effective reinforcement for epoxy, highlighting their potential for various applications requiring enhanced material properties. Further research could explore optimizing CNW dispersion techniques and investigate the impact of functionalized CNWs on the nanocomposite's performance.

9:30–10:00 **NETWORKING BREAK & EXHIBITS**

10:00–10:30 **BUSINESS:** **2024 Composite Market Vision**

Paul Salach, *Owens Corning*

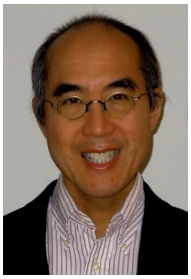


BIO: Paul Salach is a graduate of Michigan State University with a degree in Applied Engineering Sciences with concentrations in Supply Chain and Packaging. He began his career at Owens Corning in 2017 as a member of their Supply Chain Leadership Program. In 2020 he transitioned to marketing as a Strategy Analyst where he provided executive level recommendations on organic growth opportunities across Owens Corning's three businesses. He currently serves as Product Manager for Type 30 Single End Rovings in the Americas region while pursuing his MBA at Chicago Booth.

ABSTRACT: 2024 is a year of great uncertainty with rising geopolitical tensions, lingering inflation, and national elections across a number of major democracies. This presentation will cover key secular trends, the global market outlook for composites and deep dive into a few key growth areas such as infrastructure, renewable energy, building & construction and transportation. Additional topics being discussed will be the growing importance of sustainability, and actions Owens Corning is taking to address these issues for the composites industry, along with regional and global economic forecasts for the composites industry.

10:30–11:00 **PROCESS TECHNOLOGY:** **Flat AC Dielectric Sensors for Flow Front Montoring in VARTM**

Huan Lee, *Lambient Technologies*



BIO: Huan Lee is an electronics engineer with more than 30 years experience designing instrumentation for the composites industry. He has graduate degrees from the Massachusetts Institute of Technology, where he was part of a research group that worked on dielectric cure monitoring. He is also a co-founder of Micromet Instruments, which first commercialized the technology developed at MIT.

In 2008 he co-founded Lambient Technologies LLC with Stephen Pomeroy to advance the use of dielectric cure monitoring for thermosets and composites.

Abstract on next page

ABSTRACT: Vacuum Assisted Resin Transfer Molding (VARTM) is a closed mold process with a tool on the bottom side to hold a preform, and a vacuum bag on the top side, which allows atmospheric pressure to assist resin infusion. A major concern with VARTM is uneven resin flow and the formation of dry spots, where resin does not properly infuse the preform and introduces a defect. Flow front monitoring is therefore an important quality control procedure.

One means of flow front detection uses a grid of thermocouples or DC sensors, requiring penetration of the vacuum bag for direct contact with the resin. Because AC dielectric sensors can measure through insulators, they can be placed outside the bag, eliminating the need to puncture and reseal it for installation. As a result, AC dielectric sensors remove the possibility of leaks while still enabling flow front detection. Inexpensive flat dielectric sensors can be easily adhered to a vacuum bag, and a newly developed linear sensor of this type has demonstrated continuous measurement of resin flow along a line that can be extended across large parts. Unlike a grid of thermocouples or DC sensors, this linear sensor uses simple wiring that would greatly decrease the effort and cost of installation. An additional advantage of AC dielectric sensors is the ability to monitor cure through the vacuum bag after full resin infusion.

Used in the manufacture of aircraft fuselages and wings, wind turbine blades and other mid- to large sized products, VARTM has the advantage of lower tooling cost, reduction of volatiles and processing without use of an autoclave. Flat AC dielectric sensors can greatly facilitate the study of resin flow fronts during process development and in manufacturing as well with little added cost and no change to the work flow or bagging process.

11:00–11:30 **MATERIAL TECHNOLOGY: BEVs, Hybrids and the Drive to Lightweighting - Adhesives to Assist in Composites Growth**

Stephen Webb, *Parker LORD*

BIO: Stephen Webb has been with LORD and now Parker LORD for 25 plus years. He has held various roles from chemist, technical service manager, global product integration, business development, sales and global key account manager within various market segments. Currently, Stephen works in applications engineering ensuring implementation of solutions from design phase through final production implementation.

ABSTRACT: The drive towards Battery Electric Vehicles (BEV's) and Hybrids as well as the macro trend of lightweighting offer growth potential to the thermoset composites market. Composites are uniquely positioned to capitalize on this trend in growth. This discussion will cover adhesive solutions for composites and hybrid material joining as well as examples for BEV's, battery enclosures, final mile vehicles and heavy duty truck segments utilizing thermoset composites. In addition to highlighting these examples and selection criteria, this discussion will address some of the challenges and macro trends for thermoset composite industry in the electrification space.

11:30–12:30 **NETWORKING LUNCH** *Sponsored by* THERMOSET TOPCON WORLD'S LEADING THERMOSET TECHNOLOGY CONFERENCE & EXPO *Presented by SPE Thermoset Division* **& EXHIBITS**

DAY 2 PM MODERATOR: Sean Campbell, *Chair* **TOPCON -** *LyondellBasell*

12:30–1:00 **PROCESS TECHNOLOGY: Controlling Viscosity of Filled Composite Systems**

Erik Antonio, *Omya*

BIO: Erik Antonio, Ph.D. is a polymer scientist with Omya based out of the Omya Technology Center in Cincinnati, Ohio. As part of this role he leads the polymer lab in innovative research, collaborates across Omya's international R&D network, works closely with sales and distribution team members, and deals with technical support for customers in PVC, polyolefin, and thermoset applications. Erik has developed extensive knowledge of physical properties testing for polymer composites in the lab, as well as experience in polymer processing and extrusion. He has published and presented on topics of additive manufacturing, polymeric coatings, and polymer composites. Erik earned his bachelor's degree in Chemical Engineering from Mississippi State University and Ph.D. in Material Science and Engineering from Clemson University.

ABSTRACT: Viscosity is a fluid's resistance to flow and is critical aspect of thermoset applications. A closer look at viscosity reveals a system undergoing different stresses and the complex reaction that follows. The viscosity of filled resin systems can be problematic with changes in viscosity disrupting the process. For industrial applications, viscosity remains a significant control parameter in evaluating product and process quality. Understanding the factors that influence viscosity offers a level of control and opportunity to optimize. Fillers are often used to lower costs, but they may increase the complexity of the system. Within a liquid composite system of calcium carbonate and resin, such as an unsaturated polyester resin, mineral properties contribute to the overall suspension viscosity. This presentation will discuss filled resin systems and the factors that control suspension viscosity. We will focus on calcium carbonate filled systems, how changes in filler properties influences methods of formulating, and the effects calcium carbonate or filler loading and particle size distribution. The effect of particle size distribution and the filler's resulting maximum packing fraction on viscosity will be discussed in detail with multiple case studies to outline the impact in open and closed molding thermoset applications.

From visual inspection, parts are fabricated with undetectable wrinkles using a wet layup process and a hot press for curing. Scans were performed in a conventional immersion tank scanning system, and the scan data was analyzed for wrinkle detection and characterization. Extraction of the layers was performed based on tracking voltage peaks from A-scans in a time domain. Spatial Gaussian averaging was performed to smooth the A-scans, from which the surfaces are extracted for each individual lamina. The extracted winkle surface aligns with the anticipated wrinkle geometry.

1:00–1:30 **PROCESS TECHNOLOGY:** **The Thermoset Factory of the Future: Utilizing Real-Time Material Characterization and Process Simulation**

Alec Redmann, ***sensXPERT - technology by NETZSCH***

BIO: Alec Redmann is the Division Manager for thermosets and composites at NETZSCH. His current focus is developing solutions for sustainable manufacturing and process optimization. Prior to joining NETZSCH, he worked in composite manufacturing and R&D roles for applications ranging from wind turbine blades to sporting goods. Alec received his PhD in Mechanical Engineering from the Polymer Engineer Center at the University of Wisconsin-Madison.

ABSTRACT: Material deviations in thermoset manufacturing can cause dramatic issues with process stability and scrap. Environmental influences, batch-to-batch variations, and material aging may lead to changes in material flow or cure. Today's competitive environment demands improvements in cost-efficiency and defect reduction utilizing automated production control and digital solutions. This presentation will introduce the newest tools being developed and utilized by state-of-the art thermoset manufacturers. Case studies will be presented for automotive and aerospace applications to demonstrate how in-mold material measurements and simulation are being used to improve efficiency and create sustainable manufacturing processes.

1:30–2:00 **BREAK & EXHIBITS**

2:00–2:30 **PROCESS TECHNOLOGY:** **Moldex Enhancing Electromobility: Advancements in Compression Molding Simulation**

Harshal Bhogesra, ***Moldex3D***

BIO: Harshal Bhogesra graduated from the UMass Lowell with a bachelor's degree in Plastics Engineering. He has 8+ years of combined experience in molding, customer & supplier development. He is passionate about optimizing product designs, tool development, molding processes, and quality. Currently working with plastic, rubber, LSR, MIM, RTM, Gas-Assist molding companies and help them eliminate their complex molding challenges to reduce engineering time and cost. Through Moldex3D technology, he has helped clients in various industries including automotive, medical, aerospace, electronics, consumer products, etc. who are concerned by the trial and errors on the production floor. Outside of work, he is fervent about traveling, interior designing, NFL, and adventure sports.

ABSTRACT: The automotive industry is undergoing a significant transformation with the emergence of electromobility and the increasing focus on lightweight design. In this context, the global market for battery electric vehicles (BEVs) is experiencing robust growth, steering the future of automotive design towards electrification. A critical aspect of this evolution is the development of efficient and reliable battery housings, necessitating advanced manufacturing techniques. Moldex3D, a leading simulation software, is at the forefront of this technical revolution, introducing a novel compression molding approach. This approach is pivotal for improving the simulation accuracy of the single-stage direct long-fiber thermoplastic (D-LFT) compression molding process, especially relevant for creating lightweight yet robust battery housings for BEVs.

The innovatibe feature of Moldex3D's simulation capability is the ability to mimic the behavior of moving cooling channels with the mold plate, enhancing the realism and accuracy of simulations. This advancement offers substational benefits, including significant improvements in computational time and weight accuracy. These enhancements are crucial for predicting the accurate weight of battery housings, a key factor in balancing the overall weight of electric vehicles, especially considering the substantial weight of EV batteries.

Furthermore, Moldex3D extends its capabilities to encompass process and Finite Element Analysis (FEA) integration, providing a comprehensive simulation environment. Users can simulate the response of Sheet Molding Compound (SMC) parts with heightened confidence, leveraging Moldex3D's robust solver API for precise fiber orientation calculations. This comprehensive suite of simulation tools and methodologies positions Moldex3D as an essential asset in the design and manufacturing of components for the next generation of electric vehicles, aligning with the industry's drive towards electromobility and lightweight design.

2:30–3:00 **SUSTAINABILITY:** **Performance of BMC Composites with Sustainable Raw Materials**
Don Wood, ***LyondellBasell***

BIO: Don Wood gained a doctorate in Semiconductor Materials Science for Photovoltaics from the Royal Military College of Science (UK) in 2000 after a short career in the Royal Air Force. He has worked in process engineering and Research and Development at companies including Dow Corning, Dow and DuPont. Don has worked at LyondellBasell since March 2023 to develop new composite products, with a focus on development of composites containing sustainable raw materials.

ABSTRACT: During their use life, thermoset composite materials, such as bulk molding compound (BMC), reduce the environmental impacts of many products. For example, parts manufactured from composite materials may be stronger for a given weight than the metallic parts that they replace, reducing energy use of cars and aircraft. Their configuration flexibility and corrosion resistance enables energy efficient designs with longer lifetimes than alternative materials.

In addition, the energy requirement to manufacture thermoset composite parts by compression or injection molding may be lower than that for cast metallic parts, such as cast magnesium or steal, on a performance adjusted basis due to the lower processing temperature. However, opportunities exist to further enhance the environmental benefits of using composite materials. These include the use of sustainable raw materials in their initial manufacturing and the end-of-life recycling of thermoset composite materials. End-of life recycling reduces the pressure on landfill sites and re-captures the encapsulated energy from the recycled component. To be economically sustainable, these solutions must simultaneously be at least at cost/performance parity.

This presentation explores LyondellBasell's use of cost effective sustainable raw materials to provide economically viable high performance BMC. We demonstrate the recycling of a post-industrial BMC in a metal-replacement application production scale, for which we received a finalist 2023 SPE Innovation Award in partnership with Valeo and GM. We have explored the limits for use of re-ground BMC (post-industrial recycle) and the impact of content on mechanical performance. Our use of other sustainable raw materials in the manufacturing of BMC will also be presented, including post-industrially recycled glass, hemp and alternative fillers.

3:00–3:30 **SUSTAINABILITY:** **End of Life Considerations for Thermosets: Current State -of-the Art**
Jeff Gotro, ***InnoCentrix***

BIO: Jeff Gotro, Ph.D., is the President and Founder of InnoCentrix, LLC. InnoCentrix provides a wide range of consulting services to the polymer industry. Jeff has over forty years of experience in polymers having held scientific and leadership positions at IBM, AlliedSignal, Honeywell Electronic Materials, National Starch Electronic Materials, and InnoCentrix. He has published five book chapters including Thermosets in the Encyclopedia of Polymer Science & Technology, John Wiley & Sons, 2017. Jeff has authored or co-authored over 61 papers in technical journals and conference proceedings. Dr. Gotro holds 15 issued US patents. Jeff has a Bachelor of Science in Mechanical Engineering and Materials Science from Marquette University and a Ph.D. in Materials Science from Northwestern University with a specialty in polymer science (polymer chemistry, physics, and characterization).

ABSTRACT: Thermosetting polymers are widely used due to their high thermal stability, good mechanical properties, and ease of processing. The fully cured crosslinked network provides both outstanding thermal stability and poses challenges with regards to end-of-life. Unlike thermoplastics, cured thermoset resins and composites are not easily recycled and subsequently re-used (such as remelting a recycled PET water bottle). There are many emerging approaches to chemically recycling thermoset resins. This paper will present an overview of the current approaches to address the end-of-life considerations in thermoset materials. One promising approach is to incorporate dynamic covalent bonds into the thermoset backbone. Covalent adaptive networks are commonly called vitrimers (term coined by Leibler in 2011). Another approach is to use a cleavable linkage in the hardener used in epoxy chemistry called Recyclamine® (Aditya Birla). Recyclamine® Technology is a platform chemistry with multiple unique amine curing agents containing specifically engineered cleavage points at cross-linking sites, which, under pre-defined conditions, convert thermosetting epoxies into thermoplastics enabling recycling. The paper will cover the history, current approaches and future work addressing end-of-life considerations in various types of thermosetting systems.

3:30–3:45 **CLOSING COMMENTS**

3:45 **CONFERENCE ADJOURNS FOR THE YEAR**

SPE THERMOSET DIV. BOARD OF DIRECTORS:

SEAN CAMPBELL, LYONDELLBASELL - DIVISION CHAIR

Sean Campbell has been in many different roles within the Plastic Industry for the past 30 years. Sean has worked as an Account Manager and Marketing Manager at GE Plastics in both Engineering Thermoplastic and in Thermoplastic Composites. Sean worked in Senior Management for Freudenberg at the Vitech Venture as a General Manager in Plymouth, Michigan and as the Division President in Hopkinsville, KY. Sean has worked in the Thermoset Composite Industry for 5 years at A. Schulman and at LyondellBasell as a Leader in Sales and Marketing.

Sean has a Polymer Science Degree from Pennsylvania State University and an MBA from St. Joseph University in Phil, Pa. Sean has 3 grown children and enjoys golf, working out and long distant swimming.

RICK FAULK, MAR-BAL – PAST DIVISION CHAIR

Rick has been in the Thermoset industry for over 30 years. He has worked in most areas associated with the manufacturing and sale of composite materials and molded components. As product manager, Rick is responsible for taking composite applications from concept into full scale production. This business development process requires him to collaborate with OEM's, custom molders, captive molders, and the associated support functions. Mar-Bal, Inc., is headquartered in Chagrin Falls, Ohio and Rick has been there for the last six years. He has enjoyed participating with the MBI team and contributing to their sales growth, technological advancements and overall success.

Rick brings a wide variety of knowledge, experience, and an extensive business network to the SPE- Thermoset Division Board of Directors. He has served in various positions on the board and has been active member with SPE since 2006.

GREG SPAETH, PLENCO –SECRETARY/ TREASURER

Greg Spaeth is Project Engineer at Plastics Engineering Company (PLENCO). PLENCO is headquartered in Sheboygan, WI and is a leading North American manufacturer of phenolic resins and thermoset molding materials. Mr. Spaeth holds a BS in Mechanical Engineering.` He carries out special research and development projects, including material development and specific part functionality testing. With the PLENCO Technical Service Department, he works with customers to prototype new tooling and cut costs through process improvement projects. His work now includes providing part optimization and design input utilizing PLENCO's Finite Element Anaylysis capabilities.

LEN NUNNERY, PLENCO – DIVISION COUNSELOR

Mr. Nunnery's career has been spent leading the commercial organizations of various composite, elastomer (rubber / silicone), plastics and resin interests through mixed organic and inorganic growth initiatives. He has worked under vertically integrated models that include the development and manufacture of highly customized materials complimented by the production of precision components and assemblies (employing same said material products). Mr. Nunnery possesses a unique depth of knowledge in composites, plastics and elastomer technologies, the markets served, the commercial landscapes associated and the regulatory issues affecting the spaces.

Mr. Nunnery's career endeavors have been supplemented by extensive exposure to private equity organizations, M&A, enterprise integration, product rationalization and exit processes. The ability to build strong strategic plans, institute and administer mission focused KPIs, select and manage the most effective people and deliver / report growth results to the investment and finance industry's most reputable sponsors have been critical aspects of his success. Mr. Nunnery has excelled under sponsored portfolio business models.

Across his twenty-five years in technical / commercial roles, Mr. Nunnery was directly involved with numerous material conversion programs (metal to polymer based solutions) involving the transportation (both light and heavy), medical device, industrial, infrastructure, military, aerospace, sport, food service and appliance markets. These conversions have led to over $1B in industry sales.

Mr. Nunnery has produced original technical content and authored several white papers. He has presented his work (including overviews of a composites processing patent he was issued) at dozens of international university, association and trade events. In addition, he has written numerous articles and technical overviews for a collection of industry tabloids and corporate briefs.

BOARD OF DIRECTORS

GLADE SQUIRES, OMYA - BOARD MEMBER

Glade Squires holds an Undergraduate and graduate study in Chemistry University of Pittsburgh and has over 40 year's experience in the Flame Retardant industry. Mr. Squires has held positions in Flame Retardant synthesis in R&D, Commercial Development, Sales and Marketing, and has experience in all Flame Retardant chemistries.

Further professional titles for Mr. Squires include Former Vice President of the Fire Retardant Chemicals Association and Former board member of the Massachusetts Chemistry and Technology Alliance.

On a personal level, Mr. Squires contributions include: Former President and Commissioner of the Pennsylvania Fish & Boat Commission; President of the West Chester Fish, Game & Wildlife Association; as well as Hunter Safety Instructor Pennsylvania Game Commission.

WALTER SCHUTZ, ICT MOLDING SOLUTIONS – BOARD MEMBER

Walter "Bud" Schutz Jr is president of ICT MOLDING SOLUTIONS INC a company he founded in 2014 which specializes in Injection / Compression and Transfer molding of Thermoset molding compounds consisting of both polyester & phenolic along with many other well-known materials including most engineered and commodity Thermoplastic resins.

Over his 27 year career, Walter has been involved in many aspects of the manufacturing & business sector of molding and all its related facets. He served as a tool and die apprentice and over the years evolved up to Production Engineer of molding and secondary sub-assemblies. To go along with the manufacturing side Walter also possesses strong leadership skills serving many years as Director of Operations and Director of New Business Development.

Moving forward Walter is eagerly pursuing many cutting edge technologies to help the Thermoset industry stay strong and prosperous, some of which include high speed molding techniques along with environmentally friendly low impact mold building design practices. He currently resides in Northwest Pennsylvania with his daughter, Emily.

TOM HAAG, FOX VALLEY MOLDING – BOARD MEMBER

Tom Haag is President of Engineering, Quality and Sales for Fox Valley` Molding, a custom processor of thermoset molding compounds and engineering grade thermoplastics.` He has a BS in Mechanical Engineering from the University of Illinois, Champaign. Mr. Haag has been with Fox Valley for 15 years and has 22 years of experience within the plastics industry.` His various roles included Manufacturing Engineer, Injection Molding Process Engineer, mold design, quality control and sales.` He resides in New Lenox with his wife and children.

DALE SILVERNELL, IDI COMPOSITES INTERNATIONAL – BOARD MEMBER

Dale Silvernell began his career at Caribe GE in Patillas, Puerto Rico in 1992, where he learned about Thermoset Molding Compounds while working at supporting electrical vehicle controls assembly. Dale joined IDI Caribe, Inc., Salinas, PR in 1993. He has been a Senior Manager since 2005. Dale was Site Operations Manager Shanghai, China for two years and stayed in China until 2015. Currently reporting to GM and VP of North America. Since being with IDI, Dale has lived and worked in Puerto Rico; San Luis Potosi and Mexico City, Mexico; Shanghai, China and now Noblesville, IN USA.

'I have had the opportunity to travel and support customers throughout most of South America, North America, Western Europe, and a large amount of Asia. Have seen the massive opportunities for thermosets with a multitude of applications and markets... basically everything except "clear". I know a little about a lot of "stuff"... molding; tooling; formulating; a little management here and there. Primary role today is supporting global electrical OEMs, this of course due to doing the same thing in multiple countries for more than two decades (damn I'm old)', says Dale.

Dale is a US Army Veteran, 1985 - 1991 Desert Storm. Dale holds a Bachelor of Business Administration from Columbia College Caguas, Puerto Rico, 1999.

VINOD ARORA, CORE MOLDING TECHNOLOGIES – BOARD MEMBER

Vinod Arora is Director of Materials and Technology with Core Molding Technologies, a custom molder and processor of engineered composites headquartered in Columbus, Ohio. Prior to Core, Vinod has worked with other custom processors in similar industries and also in the paper and rubber industry. `He has a BS and MS in Chemical Engineering. Mr. Arora has been with Core Molding for 15 years and has more than 30 years of professional experience in materials, design, processing and manufacturing including compression, transfer and injection molding. `He resides in Spartanburg, SC with his wife, has 4 grandchildren, enjoys tennis and teaches Yoga and Pranayam.

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