
# AUTOMOTIVE PLASTICS NEWS

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

FALL 2020
VOL 50, ISSUE 1


## AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION

**September 9-11, 2020 • Virtual Conference**

*Presented by SPE Automotive Division and SPE Composites Division*

## AUTOMOTIVE COMPOSITES CONFERENCE AND EXPO (ACCE) 2020 VIRTUAL EVENT TRIUMPHS AND SETS PRECEDENT FOR FUTURE HYBRID EVENTS

**MARK YOUR CALENDARS**
**ACCE 2021 – SEPT. 8-10**

The 20th annual Automotive Composites Conference & Exhibition (ACCE) Virtual Event, organized by SPE's Automotive and Composites Divisions, was a success as a Virtual Event according to sponsors. "Congratulations on another successful ACCE!" said Stephen Greydanus – Automotive Business Development Manager, Hexion, Inc. "This year was especially tough – we know," continued Greydanus, "Hexion appreciates your efforts and we are proud to be an ongoing sponsor."

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spe AUTOMOTIVE

# MEETING SCHEDULE & SPECIAL EVENTS CALENDAR

**SPE Auto. Div. Board Meeting**
via Webex – Contact Us for Meeting Link 5:30 - 7:30 p.m.
October 19, 2020

**50TH-ANNUAL INNOVATION AWARDS GALA**
Postponed to November 10, 2021

**SPE Auto. Div. Board Meeting**
via Webex – Contact Us for Meeting Link 5:30 - 7:30 p.m.
December 7, 2020

**ANTEC 2021 THE HYBRID EDITION**
**Call for Papers Deadline** November 15, 2020

**ANTEC 2021 THE HYBRID EDITION**
Denver, CO Dates & Format to be Announced

Automotive Division Board of Directors meetings are open to all SPE members. All events are listed on our website at http://speautomotive.com. Email **Alper Kiziltas** at auto-div-chair@speautomotive.com for more information.

# CHAIR'S WELCOME

## ALPER KIZILTAS, SPE AUTOMOTIVE DIVISION CHAIR

The pandemic has certainly sent us sailing through hard times, but the silver lining is that we've discovered how to work and provide value for you and our society in this difficult time. Thank you for being there for us and allowing us to continue communicating with you through our virtual event and newsletter. A big thank you also to all volunteers for their service and time spent to make SPE Automotive Division so strong.

Our recent events include the annual golf outing (Fieldstone Golf Club in Auburn Hills, on Tuesday, September 8th) and the first virtual Automotive Composites Conference and Exhibition (ACCE, September 9-11th). Despite the rain and COVID 19, the golf outing was a success. Automotive and Composites Division' ACCE celebrated its twentieth year with the first virtual event that hosted a stellar slate of keynotes, panelists, and speakers. Under the theme, "Driving Innovative Transportation," two keynote speakers outlined the future of auto composites from all angles. Always a high point in the ACCE schedule is the annual panel discussions. The panels considered a question on many minds at the conference: "How 3D Printing Is Changing the Automotive Composites Business" and "Sustainable Materials Management and the Circular Economy". We really appreciate the ACCE executive committee, SPE HQ team, session chairs, speakers, panelists, and students' willingness to pivot the agenda for the ACCE meeting to focus on science and technology during the COVID-19 pandemic. We are especially grateful to our sponsors. Without them, ACCE and the annual golf outing would not be possible.

Needless to say, this pandemic has significantly impacted conferences and meetings. Since the Automotive TPO Engineered Polyolefins Global Conference and the Innovation Awards Gala, known as the Oscars of the plastics and composites industry, are heavily weighted on networking and interaction of attendees, we are all utterly heartsick that these events have been canceled. Committees will monitor the pandemic situation concerning scheduling of these events in 2021. For more details on these and future events, please go on our website **http://speautomotive.com/** and go to the events link – we hope to see you there.

At any time, if you have ideas on how to make our division better or would like to volunteer, do not hesitate to contact me at **auto-div-chair@speautomotive.com.**

Please stay safe and take care of yourselves.
All the best, and thank you,
***Alper Kiziltas***


**BY TERI CHOUINARD, SPE AUTOMOTIVE DIV. COMMUNICATIONS CHAIR**

"In spite of the challenges with the pandemic and the event having to go virtual, the leadership team did a great job putting together an excellent program," said Erik LaBelle - Automotive Technical Business Development Specialist at 3M." The virtual platform was well organized and navigating both the live technical program and the conferencing/networking platform was very intuitive," added LaBelle. "All things considered - I think it was a great success!"

"From my perspective, the conference went without a hitch from a technology perspective – a huge win! And I enjoyed the look and feel of the networking sessions – it was a very effective way to connect with people on a bit more of a personal level, as best we can in a virtual setting," said Liz Blankenhorn – Market Segment Manager, Transportation - Dispersions & Resins North America at BASF Corporation. "All-in-all, excellent job with the event as it's truly such a challenge to design these virtual events and this was one of the best I've been to so far," added Blankenhorn. "Thank you for your dedication to all the work that was required to execute - I'm looking forward to attending again next year."

The ACCE team elected to move forward as a virtual event to continue its mandate to educate the global transportation composites supply chain on the latest developments in polymeric materials, process, machinery and applications. Known as "The World's Leading Automotive Composites Forum," the conference is continuously improving and advancing the industry.

Excellent leadership was provided from returning ACCE Co-Chair, Dr. Alper Kiziltas, technical expert, Ford Motor Company and SPE Automotive Div. Chairman and Dr. Xiaosong Huang, lab group manager of Polymer Composites Systems in GM Global Research & Development, General Motors Company. The technical program was co-chaired by Dr. David Jack, associate professor, Mechanical Engineering at Baylor University and Dr. Leonardo Simon, professor, Chemical Engineering at University of Waterloo - who have managed the program for many years — and new co-chair Dr. Oleksandr G. Kravchenko, assistant professor, Composites Modeling and Manufacturing Group, Department of Mechanical and Aerospace Engineering and Old Dominion University.

## 40 REMOTE PRESENTATIONS ON THE LATEST AUTOMOTIVE COMPOSITES TECHNOLOGIES

This year's technical program included 40 presentations on the latest advancements in thermoplastic and thermoset composites; enabling technologies; reinforcement technologies; additive manufacturing and 3D printing; carbon composites; modeling; bonding, joining and finishing; sustainable composites; and business trends and technology solutions. Speakers from around the world (5 different countries – USA, Canada, Germany, Netherlands, Turkey) presented remotely with technical direction and support from SPE Headquarters staff.

Sponsored commercial presentations (1-2 minutes) were incorporated into the program as "Session Sponsorships" which enabled companies to feature their technology with a sales flair while bringing new revenue to the event.

**DR. ALPER KIZILTAS**

**DR. XIAOSONG HUANG**

**DR. DAVID JACK**

**DR. LEONARDO SIMON**

**DR. OLEKSANDR (ALEX) G. KRAVCHENKO**

# ACCE 2020 KEYNOTE SPEAKERS

## KEYNOTE SPEAKER 1

The first keynote of the conference, **"Automotive Plastics & Polymer Composites: A Roadmap for Future Mobility,"** was delivered by **Jose Chirino, American Chemistry Council Automotive Team Chair & Technical Director for the High Performance Materials business unit at LANXESS Corporation.** His presentation outlined how the American Chemistry Council's new roadmap will help automakers and their suppliers invent mobility solutions that can meet the demands of the revolution underway in personal mobility. The new roadmap calls for a series of industry-wide, collaborative activities to capture opportunities in each area of the ACCESS framework – Autonomy, Connectivity, Circularity, Electrification, Shared Mobility and Sustainability. These pre-competitive efforts will help automakers unleash the full potential of the advanced plastics and composites essential to enabling future mobility needs.

"Mobility solutions of the future will be enabled by the unique and flexible characteristics inherent in polymer composites," said Chirino. "Composites enable safe and seamless integration of sensors, electronics, and batteries into vehicles without adding extra weight," added Chirino. "Automotive fuel economy is improved and greenhouse gas emissions are reduced with the mass savings enabled by lightweight plastics and polymer composites," continued Chirino. "Polymer composites can also enhance interiors with improved wear and tear, antimicrobial surfaces, and enable modular and multi-configurable interior components desired in shared and autonomous vehicles."

### About Jose Chirino:

Jose became the Chair for the ACC Automotive team in the Spring of 2019. The ACC Automotive team is a pre-competitive forum of plastics industry experts promoting broader polymer solutions for the automotive industry.

Jose Chirino is the Technical Director for the High Performance Materials business unit at LANXESS Corporation, leading the Americas technical team on the development of new products and applications for engineering plastics in automotive and the electronics industries.

His 20 years of experience in plastics, encompasses the spectrum of production to end-product, and design through application development with various polymers such as: polyurethanes, polycarbonate, polyesters and polyamides.

Jose holds a degree in Chemical Engineering from the National Autonomous University of Mexico (UNAM).

## KEYNOTE SPEAKER 2

The second keynote of the conference, **"Greener Materials for a Greener World,"** was presented by **Dr. Deborah Mielewski, Senior Technical Leader of Sustainable and Advanced Materials at Ford Motor Co.** Her presentation highlighted the broad portfolio of greener materials available now and in the future that can reduce the carbon footprint of the automotive industry and other industries worldwide.

Dr. Mielewski initiated the biomaterials program at Ford in 2001, and her team was the first to demonstrate soy-based foam that met all the requirements for automotive seating. Ford launched soy-based foam on the 2008 Mustang, and soy seat cushions, backs and headrests have found their way into every Ford North American built vehicle. "Bio-based foams currently reduce Ford's greenhouse gas emissions by over 25 million pounds and reduce petroleum dependence by over 5 million pounds annually," said Mielewski. "Ford now has over 10 renewable materials in production vehicles including natural fiber reinforced composites such as wheat straw, rice hulls and cellulose fiber from trees with many of them exceeding the performance of traditional plastic composite materials," continued Mielewski. "Over the past five years, we have kicked off several new material investigations with cellulose nanofibers, materials from carbon dioxide, and we are applying our knowledge in green materials to the exploding area of 3D printing."

### About Dr. Deborah Mielewski:

Dr. Deborah Mielewski is the Senior Technical Leader of Sustainable and Advanced Materials at Ford Motor Company. She received her B.S.E. ('86), M.S.E. ('93) and PhD ('98) degrees in Chemical Engineering, all from the University of Michigan in Ann Arbor, and has been with Ford Motor Company for 33 years. Dr. Mielewski has worked at Ford Research in automotive paint durability, polymer processing and materials development.

Dr. Mielewski is passionate about the work she does to reduce Ford's environmental footprint and believes that these new materials are going to dominate the market in the future. Her philosophy is to "do the right thing" in incremental, but ever advancing steps. She has appeared in a Ford national commercial, the NOVA "Making Things" series, and has been interviewed by countless media outlets, including Wall Street Journal, Cheddar, Time Inc. and CNN. She has over 60 referred journal publications and 20 U. S. patents. Her work has been acknowledged with awards such as the Henry Ford Technology Award, the R&D100 Award, the Free Press Automotive Leadership Award, the Environmental Management Association Award, 5 SPE Environmental Innovation Awards and the American Chemical Society's Industrial Innovation Award. She has spoken at prestigious outlets such as TED and the Smithsonian "Age of Plastics Symposium".

# ACCE 2020 PANEL DISCUSSIONS

## PANEL DISCUSSION 1

The first panel discussion, **"How 3D Printing Is Changing The Automotive Composites Business,"** was moderated by ACCE Co-Chair Dr. Alper Kiziltas, Technical Expert, Ford Motor Company and included panelists David Tucker, Additive Manufacturing Engineer, HP Inc.; Wiener Mondesir, Chief Technology Officer and Co-founder, Areo, Inc.; Dr. Ellen Lee, Technical Leader Additive Manufacturing Research, Ford Motor Company; Cindy Kutchko, Senior Group Leader, Additive Manufacturing, PPG Industries; Greg Constantino, New Business Development & Application Specialist, DSM Additive Manufacturing; and Somansekhar Bobba, Global Automotive Technical Manager, Sabic Specialties. The discussion included references to the panelists' experiences with the technology and projections for future applications. The discussion highlighted some of the most ideal applications as: those that can be applied onsite (3D printers can be brought to the location), short-run prototypes or production parts, assembly line jigs and fixtures, and very complex parts.

## PANEL DISCUSSION 2

The second panel discussion, **"Sustainable Materials Management and the Circular Economy"** was also moderated by Dr. Alper Kiziltas, Technical Expert, Ford Motor Company and included panelists Sanjay Jain, Vice President, Marketing and Sales, DSM; Thomas McKay, Segment Manager, Sustainability Champion, BASF Performance Materials; Dr. Deborah Mielewski, Senior Technical Leader, Sustainable and Advanced Materials, Ford Motor Company; Amar Mohanty, Professor and Premier's Research Chair in Biomaterials & Transportation, University of Guelph; Kanchana Sonti, Product Steward, HP Inc.; and Mitchell Toomey, Director of Sustainability, BASF Performance Materials.

The panelists identified how they are incorporating resins with biomaterials into their products and planning for increasing sustainability practices at their companies. Enthusiasm for newer technologies including chemical recycling (converting mixed plastic waste by using a solvent to depolymerize the resin and release fibers and fillers that can be recovered from the resin and reused was expressed. The panel also expressed their personal dedication to improving the environmental impact of plastics and polymer composites worldwide.

# ACCE 2020 STUDENT POSTER COMPETITION

SPONSORED BY

## STUDENT POSTER COMPETITION TRADITION CONTINUES IN A VIRTUAL FORMAT

The ACCE 2020 Virtual Event continued the tradition of providing a platform for students from the U.S.A. and international universities to present their innovative research related to plastic composites materials and manufacturing technologies relevant to automotive applications. This annual event is a great opportunity for the students to present their research and interact with members of the automotive composites industry. Students recorded their presentation (2-3 minute videos) and provided Power Point slides of their posters to accommodate the virtual platform. Attendees were able to view the posters online and interact with the students via a Student Poster section on the networking floor where students had tables enabling one on one meetings.

The Student Poster Competition is a great opportunity for the students to interact with members of the automotive composites industry and learn about what it is like to work as a scientist or engineer in the field. OEMs and their suppliers benefit as well as they are able to meet the next generation of automotive composite engineers and scientists and potentially to hire them.

The ACCE 2020 Student Poster Competition, sponsored by Ford Motor Company, included 47 Students (33 PhD, 6 Master of Science, 8 Undergraduate) from 25 schools in the U.S.A., Canada, Turkey and Australia. The posters and the student presentations were rated by 55 judges, who are experts in the field, from academia and industry. Students with the highest scores in a number of categories were awarded ($100 – $750 each) – $6,800 in total was distributed.

### HERE ARE THE WINNERS OF THIS YEAR'S COMPETITION:

### PhD CATEGORY DESIGN, MODELING, SIMULATION, RECYCLING:

**1ST PLACE**

*Rate and Temperature Effects on the Crashworthiness of Automotive Grade Discontinuous Recycled Carbon Fiber Organosheet Composites*

**Philip Barnett,**
PhD Student, University of Tennessee

**2ND PLACE**

*Residual Deformation Analysis in Composite Shell Structures Manufactured Using Automated Fiber Placement*

**Von Jamora,**
PhD Student, Old Dominion University

**3RD PLACE**

*Thermoforming Process Induced Structural Performance of Carbon Fiber Reinforced Thermoplastic Composite Part Through a Novel Manufacturing to Response Pathway*

**Madhura Limaye,**
PhD Student, Clemson University

### PhD CATEGORY NANO / BIO / ADDITIVE MANUFACTURING:

**1ST PLACE**

*Design and Engineering of Humidity Resistant Starch Composite Foams for Automotive Packaging Via Extrusion Technology*

**Apoorva Kulkarni,**
PhD Student, Michigan State University

**2ND PLACE**

*The Effects of Fiber Orientation State of Extrusion Deposition Additive Manufactured Fiber-Filled Thermoplastic Polymer on Final Part Deformation*

**Pasita Pibulchinda,**
PhD Student, Purdue University

**3RD PLACE**

*Improvement of Composite Thermal and Mechanical Properties via GO/POSS Hybrid Nano-Additives and Discussion Regarding the Importance of Additive Compatibility*

**Lynsey Baxter,**
PhD Student, Oklahoma State University

## PhD CATEGORY MATERIALS DEVELOPMENT, CHARACTERIZATION, NONDESTRUCTIVE EVALUATION

**1ST PLACE**

*Understanding Size Effects on Flexural Properties in Discontinuous Fiber Reinforced Nylon Composites*

**Siavash Sattar,**
PhD Student, Old Dominion University

**2ND PLACE**

*Nondestructive Evaluation of Large-Scale Polymer Additive Manufacturing*

**Ryan Spencer,**
PhD Student, University of Tennessee

**3RD PLACE**

*Rapid Non-Invasive Characterization of Carbon Fiber Composite Automotive Parts*

**Hannah Maeser,**
PhD Student, University of Tennessee

## MASTER OF SCIENCE CATEGORY

**1ST PLACE**

*Effect of Alkyl Ketene Dimer on the Hydrophobic and Mechanical Properties of Natural Fiber Reinforced Biopolymer Composites*

**Sena Caylak,**
Bursa Technical University, Turkey

**2ND PLACE**

*Development of Graphene/Talc Hybrid Additive from Plastic Waste by Upcycling Techniques and its Use in the Production of Lightweight Automotive Parts*

**Atakan Kocanali,**
Sabanci University, Turkey

*no photo available*

**3RD PLACE**

*Fabrication of Electrospun Polyacrylonitrile/ Lignin Nanofibers: Effects of Lignin Type and Concentration*

**Suchitha Devadas,** *University of Dayton*

**4TH PLACE (TIE)**

*Magnetic Moment and Magnetic Anisotropy Analysis of 3D Printed Strontium Ferrite PA12 Filament Composites Under Magnetic Field*

**Camila Belduque,** Texas State University

**4TH PLACE (TIE)**

*Fiber Orientation Measurements for Large Additive Manufactured Parts Using Optical and SEM Imaging*

**Rifat Ara Nargis,**
Baylor University

## UNDERGRADUATE CATEGORY

**1ST PLACE**

*Hydrolytic Degradation of Aramid Fiber in the Presence of Trace Amounts of Sulfuric Acid*

**Kara Pelster,**
Undergraduate Student Researcher, University of Delaware

**2ND PLACE**

*Micromechanical Modeling of Axial Tension Behavior of Unidirectional Composites*

**Isabel Catugas,**
Undergraduate Student Researcher, University of Delaware

**3RD PLACE**

*Analysis of Dispersion, Wettability, Viscosity and Mechanical Properties of Unsaturated Polyester Nanocomposites Consisting Dichloro Dimethyl Silane Treated Alumina Nanofibers*

**Subash Panta,**
Undergraduate Student Researcher, Texas State University

**4TH PLACE**

*Orientation Effects on Specific Energy Absorption in Recycled Carbon Fiber Organosheet Composites*

**Brett Hulett,**
Undergraduate Student Researcher, University of Tennessee

## THANK YOU!!

Special Thanks to Dr. Uday Vaidya, ACCE Student Poster Competition Chair for many years and to Douglas Smith for helping Uday in organizing the judging for this year's event.

**DR. UDAY VAIDYA**
**UNIVERSITY OF TENNESSEE-KNOXVILLE**

**DOUGLAS SMITH**
**BAYLOR UNIVERSITY**


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# SCHOLARSHIP AWARDS

## SPE® ANNOUNCES WINNERS OF THE ACCE & DR. JACKIE REHKOPH SCHOLARSHIPS FOR THE 2020-2021 ACADEMIC YEAR

Winners of the annual SPE ACCE scholarships and the Dr. Jackie Rehkopf scholarships were honored at the event. The ACCE scholarships are sponsored by the SPE Automotive and SPE Composite Divisions.The Dr. Jackie Rehkopf scholarships are sponsored by the SPE Automotive Div., SPE Composites Div., and the generous donations of friends and family via an endowed fund that has been set up to honor the long-time SPE ACCE committee member, SPE Automotive Division board member, and automotive composites researcher. The scholarships are awarded to students, anywhere in the world, who are pursuing advanced degrees in Polymer Science, Composites, Plastics, or a related engineering discipline.

The three winners of the SPE ACCE scholarships (a total of $6,000 USD/$2,000 USD each) are **Sai Aditya Pradeep**, a PhD candidate at Clemson University (Clemson, South Carolina, USA (**http://www.clemson.edu**). **Alessandro Perego**, a PhD candidate at University of Akron (Akron, Ohio, USA (**https://www.uakron.edu**) and **Nathaniel Blackman**, a PhD candidate at Baylor University (Waco, Texas, USA (**https://www.baylor.edu**).

The two winners selected this year for the Dr. Jackie Rehkopf Scholarships (a total of $5,000 USD/$2,500 each) are **Jiaqi Yan**, a PhD candidate at North Carolina State University (Raleigh, North Carolina, USA (**https://www.ncsu.edu**) and **Wencai Li**, a PhD candidate at Louisiana State University (Baton Rouge, Louisiana USA (**https://www.lsu.edu**).

### Sai Aditya Pradeep, PhD Candidate, Materials and Manufacturing, Automotive Engineering Department, Clemson University, *2020 ACCE Scholar*

Sai Aditya's PhD research focuses on the scalable production of thermoplastic nano-celular foams via supercritical fluid assisted (SCF) injection molding, geared for automotive applications. Nano-cellular thermoplastic foams offer tremendous improvements over their conventional microcellular and microcellular counterparts in terms of their lightweight potential, mechanical and thermal insulation properties, and cost savings for the automotive sector. Although lab-scale techniques like Solgel have been used in the manufacturing of nano-foams, the industry continues to face challenges in manufacturing nano-cellular foams via a scalable yet sustainable process that can match the short cycle times needed in the automotive industry.

Therefore, Aditya's research is focused on studying the process of controlling cell nucleation in thermoplastic foams using innovative tooling strategies and crystal nucleating agents in order to manufacture a reproducible nano-cellular structure via injection molding.

Aditya's work in the area of thermoset foams has culminated in publishing one journal article, three conference papers (two in SPE conferences). Additionally, his work in the area of thermoset foams has led to the publishing of three journal papers and two conference papers. He has been an active participant in SPE conferences and the work he's been involved with has received four awards including a best poster award for his PhD work at the SPE ACCE 2019 conference.

Aditya is currently engaged in projects with the Department of Energy (DOE) and Honda Research & Development Americas (HRA) focusing on the manufacturing of an Ultra-lightweight Carbon Fiber Reinforced Thermoplastic Composites Door Assembly at the Clemson Composites Center. Sai has interned at Apple, Inc. and is keen on working in Polymer R & D in the consumer electronics or automotive sectors.

### Alessandro Perego, PhD Candidate, Polymer Engineering, University of Akron, *2020 ACCE Scholar*

Alessandro Perego's research consists in using molecular dynamics (MD) simulations to study the long-standing problem of rubber waste management. The majority of the rubber in the world is used by the automotive industry, where it is processed by cross-linking natural and synthetic rubbers with the final addition of a small fraction of additives such as carbon black and

silica particles. This composition makes rubber wastes among the most challenging materials to recycle as they will not dissolve or melt. Understanding and modeling these particular polymer blends not only will provide valuable insights on how to overcome the challenges of recycling and safely disposing of industrial and postconsumer rubber wastes, but it will also help to improve the mechanical properties of the rubber compounds, which will result in a longer life cycle of rubber products. Besides, the existence of additives in rubber leads to creation of interphase between the matrix and filler particles that plays a vital role in the overall enhancement of the mechanical properties of the blend. The interfacial interactions can provide a detailed understanding of the mechanism in strengthening the interphase between filler and rubber and guide experiments to design these materials.

The objectives of his work are: (1) Provide a detailed description of the effect of interaction between elastomers and nanoparticle surface on the mechanical properties of the composite, and (2) Predict morphology of the particles in the final rubber compound. The mechanisms of enhancement of the long-time mechanical properties (low-frequency modulus and tensile modulus) and rolling resistance, which is related to the loss tangent of viscoelastic moduli can also be determined. To fully capture the interactions between rubbers and nanoparticles, a customized coarse-grained model based on the all-atom simulations will be built. This model will consider the effects of the particle surface modification and aggregation of the particles on the microstructure and mechanical properties of the final rubber compound. According to the EPA only 17.8 percent of the 8.5 million tons of rubber and leather waste streams get successfully recycled. The data he will obtain from his simulations will provide vital insights on the complex dynamics in rubber blends with fillers and help deliver a more complete picture on how to safely dispose and reuse industrial and postconsumer rubber waste streams.

**Nathaniel Blackman,** PhD Candidate, Mechanical Engineering, Baylor University, ***2020 ACCE Scholar***

Nathaniel Blackman's research is focused on carbon fiber. Carbon fiber composites are an increasingly popular material in a wide variety of industries. Today, carbon fiber composites are being used in airplanes, running shoes, athletic gear, race cars and some high-end consumer vehicles. These composites have a desirable strength-to-weight ratio, but these laminates are highly susceptible to manufacturing defects and in-service damage which can lead to a higher likelihood of catastrophic failure. The proposed research project will advance non-destructive testing of carbon-fiber composites using ultrasound, by creating algorithms and processes that automate the detection of foreign debris and low-impact damage in carbon-fiber laminates. If successful, this project will dramatically reduce the cost of implementing non-destructive testing techniques in both the manufacturing and service environments by eliminating the need for an advanced technical expert to interpret testing results. Results gained by the implementation of such testing during the manufacturing process can be used to further improve manufacturing process techniques of these advanced materials, and over time may help to make carbon fiber composites a viable design choice in more mass-market vehicles.

**Jiaqi Yan,** PhD Candidate, Chemical and Biomolecular Engineering, North Carolina State University, ***2020 Dr. Jackie Rehkopf Scholar***

Jiaqi Yan's fundamental and applied research lies in investigating polymer nanostructures, nanocomposites, and networks by various techniques. Yan works on chemistry-structure-property relationships of styrenic block copolymers, with further modifications for different applications towards automotive, membranes, biocompatible materials and so forth.

Yan received a Bachelor of Science degree in Chemical Engineering (with honors) from East China University of Science and Technology in 2016 and was later accepted as a PhD student in Chemical and Biomolecular Engineering at North Carolina State University. Subsequently, she joined the Macromolecular Materials and Morphology group in 2017 (under the supervision of Prof. Richard J. Spontak).

**Wencai Li,** PhD Candidate, Mechanical & Industrial Engineering, Louisiana State University, ***2020 Dr. Jackie Rehkopf Scholar***

Wencai Li's PhD project is to create novel thermoplastic films and demonstrate their three-fold multifunctional purpose: 1) Energy direction during ultrasonic welding (USW) of thermoplastic composites; 2) Stress or strain – sensing under load for structural health monitoring (SHM); and 3) Self-heating to allow disassembly and repair. USW is chosen to join thermoplastic composites due to its fast welding speed (a few seconds), low energy consumption, concentrated heat generation and absence of foreign material at the welding interface. This welding technology is typically employed to fusion bond unreinforced or reinforced thermoplastic using an energy director, such as a flat thermoplastic film, with high frequency and low amplitude vibrations to generate heat between adherends, while applying pressure through a sonotrode. In this project, she will investigate the use of multi-walled carbon nanotube/polypropylene (MWCNT/PP) nanocomposite films to enable ultrasonic welding and damage detection of glass fiber/polypropylene (GF/PP) composite joints. Pure PP, 15 wt%, 20 wt%, and 25 wt% MWCNT/P films were chosen to weld GF/PP adherends. The effect of MWCNT content on the ultrasonic welding process was evaluated by comparing weld quality through lap shear strength (LSS) tests and fractography analysis. Welded joints under cyclic bending and tension until failure were then studied for damage detection using real-time electrical resistance measurements. Further research is needed to improve joints' strength, as well as films' sensitivity for strain monitoring and structural health monitoring. Repairability at the interface through self-heating or disassembly with resistance heating will also be considered to extend the life of thermoplastic composites during use.

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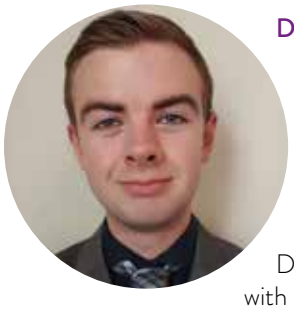
# ACCE BEST PAPERS

## SPE® AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION (ACCE) BEST PAPER AWARD WINNERS WERE HONORED AT THE VIRTUAL EVENT

The two authors who received the highest average ratings by conference peer reviewers out of a field of 40 contenders were honored for excellence in technical writing and will receive a plaque to commemorate their achievement. **Ethan Watt**, a 4th-year Undergraduate Nanocomposites student at the University of Guelph – Bioproducts Discovery and Development Centre (**https://www.uoguelph.ca** Guelph, Ontario, Canada) won first place in this year's ACCE Best Paper Award competition. **Sandeep Tamrakar**, Research Engineer, at Ford Motor Company (Dearborn, Michigan, USA) was recognized as ACCE Best Paper Award runner up.

## SPE® ACCE BEST PAPER AWARD WINNER:

### Ethan Watt, 4th-year Undergraduate Nanocomposites Student University of Guelph - Bioproducts Discovery and Development Centre



Ethan Watt is an undergraduate Nanoscience student in his fourth year at the University of Guelph. Within this field, his studies focus mainly on physical chemistry and material science. His area of focus at the Bioproducts Discovery & Development Centre is composite research, with particular interest in the incorporation of biocarbon and nanofillers into polymeric matrices.

**"Influence of Soy Hull Based Biocarbon and Graphene Nanoplatelets on the Performance of Polypropylene,"** is the title of **Ethan Watt's** award-winning paper. About this topic, the author states, "Polypropylene (PP) shows wide usage in the automotive industry, owing to its strength, chemical resistance, and processing ease. The movement away from petroleum-dependence has led to research into sustainable fillers to partly replace the PP matrix, with biocarbon (BioC) being of particular interest. However, this filler commonly diminishes mechanical strength, and to address this the compatibilizer maleic anhydride grafted polypropylene (MA-PP), as well as the nanomaterial graphene nanoplatelets (GnPs), were incorporated as a second filler. It was observed that the optimal formulation was PP/17%BioC/3%MA-PP/3%GnP, which led to mechanical and thermal properties beyond that of neat PP. Flexural strength and modulus were raised by around 28 and 59%, respectively, owing to the stiffness of the filler particles and restriction of chain mobility. This restriction in chain mobility had the added benefit of enhancing the heat deflection temperature by 28%, as well as the dimensional stability, as observed through a decrease in the coefficient of linear thermal expansion by around 17% as compared to neat PP. Overall, these biocomposites provide a direction to the improvement of PP properties while simultaneously decreasing its petroleum content, making them ideal for automotive applications."

## SPE® ACCE BEST PAPER AWARD RUNNER-UP:

### Sandeep Tamrakar, Research Engineer, Ford Motor Company

Sandeep Tamrakar is a Research Engineer at Ford's Research and Innovation Center. His research interest includes natural fiber reinforced composites, fiber matrix interfaces, viscoelastic behavior and durability analysis of polymer composites. Sandeep Tamrakar holds a Master of Science degree from University of Maine and a PhD degree in Civil Engineering from University of Delaware.

**"Water Absorption Behavior of Recycled PP and PA6 Composites Reinforced with Natural Fibers,"** is the title of **Sandeep Tamrakar's** paper that was recognized as runner-up in the ACCE Best Paper award competition. About this topic, the author states, "The recyclability of natural fiber and glass fiber reinforced polypropylene composites and glass fiber reinforced nylon composites have been studied through injection molding and mechanical grinding. Mechanical properties of virgin and recycled composites were assessed through flexural, tensile, and impact tests. No significant degradation in the mechanical properties of natural fiber composites was observed after subjecting the composites through several rounds of recycling and water absorption at ambient temperature in tap water. However, severe degradation in the mechanical properties was observed for glass fiber composites. For instance, after five cycles of recycling, only 59% of flexural strength and 64% of flexural modulus was retained for glass fiber reinforced nylon composite. This is mainly due to severe attrition in glass fibers caused by recycling as evidenced by studies on fiber length distribution. Water absorption tests conducted at room temperature and subsequent environmental conditionings such as freeze-thaw cycling and extended freeze cycling only affected nylon composites. At saturation point, water absorption for nylon composites was 7.7% by wt. after 45 days of immersion, which significantly affected the mechanical properties. The tensile strength of the nylon composites reduced from 88.4 MPa to 36.2 MPa, and modulus reduced from 5.6 GPa to 1.8 GPa after saturation."

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# EDUCATION REPORT

CHUCK JARRETT
SPE AUTO. DIV. EDUCATION DESIGN IN PLASTICS CHAIR

The SPE Automotive Division continues to support and sponsor the PlastiVan's education outreach during these challenging times. When many schools are holding virtual classroom settings, the PlastiVan team has accommodated to create training modules with lesson plans that have been developed to reach many students across many geographies. After beta testing with our initial 4-6 school groups in November (MI, ME, PA, IL), the PlastiVideos will be widely distributed to our usual markets as well as some newer markets in 2021. The SPE Foundation is also committed to delivering the PlastiVideos to the underserved communities we serve every year as well as expanding our reach to underserved students. The curriculum will continue to educate students on the foundations of plastics: History, Manufacturing, Careers, Recycling- Mechanical & Chemical,Chemical recycling, Applications, Chemistry and Engineering. You can learn more about the new program at **www.plastivan.org.** We'll look forward to providing you with updates in our next edition on the livestream and virtual training progress of the PlastiVan team. Thank you!

# ANTEC® 2021 THE HYBRID EDITION

# CALL FOR PAPERS

## DR. NORM KAKARALA & TOM PICKETT

The 2021 SPE Annual Technical Conference (ANTEC) will be a hybrid conference. There will be two and a half days of live meetings in Denver, Colorado followed by several weeks of technical presentations delivered virtually for you to watch from your location, either real time or at your convenience on demand. ANTEC® 2021 will include real-time presentations broadcast regionally as well as on-demand, pre-recorded presentations. All presentations will be available to registered attendees. ANTEC is the largest and most respected technical conference in the plastics industry. *Note live meetings in Colorado are subject to cancellation or rescheduling based on CDC guidance at the time.*

## SUBMIT A PAPER FOR PUBLICATION AND VIRTUAL PRESENTATION FOR ANTEC IN THE AUTOMOTIVE SESSION:

- Opportunity to present to interested peers.
- Educate attendees on the most recent advances in the automotive plastics industry
- Raise awareness of your research
- Grow your knowledge
- Network and meet others in your field
- Contribute to your resume and professional development

The Automotive Division Session of ANTEC is well attended each year by leaders in the Automotive Industry. **Dr. Norm Kakarala** and **Tom Pickett** are Technical Co- Chairs of the ANTEC Automotive Division Session and will facilitate your presentations at the ANTEC 2021 Automotive Session.

## THE DEADLINE IS NOVEMBER 15, 2020

Log on to the SPE website address and follow the directions to register and submit your paper. The SPE website is: **www.4spe.org/antec** or direct link to the paper submission site is: **https://www.4spe.org/i4a/pages/index.cfm?pageid=5952**

## FULL LIST OF TOPICS INCLUDE:

- Additive Manufacturing/ 3D Printing
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- Automotive
- Bioplastics & Renewable Technologies
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## CONTACTS:

For questions about papers and the technical program:
**DAVID ANZINI**
ANTEC® 2021 Technical Chair
**david.anzini@celgard.com**

For issues or questions with the submission site:
**CHRIS BARRY**
Marketing/Technology Manager, SPE
**cbarry@4spe.org**


## SPECIAL THANKS TO OUR SPONSORS AND PARTICIPANTS FOR THEIR GREAT SUPPORT!

Neither rain, nor COVID-19, nor more rain kept our SPE Golfers away from our annual SPE Auto Division outing. We have a great group of sponsors and fans of the SPE Automotive Div. Golf Outing! They love SPE and they love Golf too. It was especially nice to get together for fresh, albeit wet air, friendship and fun this year.

Despite inclement weather and COVID-19, five foursomes masked up and played 18 holes during the best part of the day. It was raining in the morning, so we adjusted for a later start and enjoyed a bit of sun for part of the day.

Thanks to our loyal sponsors, who have supported the event for many years, great fun and comradery was enjoyed by all.

### SPECIAL THANKS TO OUR SPONSORS INCLUDING:

- **Plastics Engineering & Technical Services (PETS)** who sponsored Lunch at the turn
- **ID Additives** and **Entec Polymers** who sponsored Contest Holes
- **BASF, INEOS Composites, Chromaflo** and **JSP** who sponsored Holes

### ADDITIONAL THANKS TO:

- **Crank's Catering** who provided a continental breakfast, lunch and wonderful service
- **Fieldstone Golf and Country Club** who takes very good care of us every year

Fieldstone Golf and Country Club, Auburn Hills, Michigan is consistently hailed as one of the decades top 3 public golf courses in Southeast Michigan. Fieldstone includes an exceptional variety of hole designs by the renowned architect, Arthur Hills, that mesh the diverse landscape and wetlands with gently rolling fairways through majestic hardwoods. **Next year's event will be held there on Tuesday, Sept. 7th, 2021.**

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# TREASURER'S REPORT

## BONNIE BENNYHOFF, SPE AUTOMOTIVE DIVISION TREASURER

Rainy day. It's here. The good news is we can handle the downturn! Automotive Division is on solid ground financially, and while we lost money this past fiscal year which ended June 30, 2020, we will continue to explore ways to better serve members in the days ahead.

Recapping our most significant programs for Fiscal Year 2019, two of our three major events proved to be very successful. $45,488 was added to our bottom line by the Automotive Composites Conference & Exhibition (ACCE) held in September 2019 with the Composites Division, and the Innovation Awards Gala held in November (IAG). AutoEPCON, scheduled for May 2020 with the Detroit Section, had to be cancelled.

I'm happy to say we continued to reinvest back into our industry by sponsoring educational programs and awarding student scholarships totaling $39,400 in FY 2019. We plan to top that this year!

As we begin this new fiscal year, we're careful to look at every expenditure with a judicial eye, but without compromising our goals. Even though we expect to lose money, with no revenue coming in from our major programs this year, the Automotive Division will continue to support worthwhile initiatives such as PlastiVan™, Student Chapters of SPE and scholarships to deserving individuals.

Finally, I want to extend a personal thank you to the sponsors who faithfully support the Automotive Division – you play a huge role in our financial soundness!

### AS OF OCTOBER 13, 2020, THE DIVISION'S ACCOUNT BALANCES WERE:

| | |
|---|---|
| Checking: | $387,999.94 |
| Savings: | 27,491.50 |
| **Total:** | **$415,491.44** |

# SECRETARY'S REPORT

## SPE AUTOMOTIVE DIV. BOARD MEETING MINUTES OCT. 19, 2020, VIRTUAL, BY STEVE VANLOOZEN

- Two new board members were introduced. Albert Chan with Geon Performance Solutions and Marc LaCounte with TecModo provided introductions and were welcomed to the Automotive Division.

- Changes to the Board including Committee Chairs and the Executive Committee were reviewed. Paula Kruger has officially assumed the role of Committee Chair for the newsletter.

- Teri Chouinard reviewed the details along with financial performance of the 2020 ACCE. This was the first entirely virtual event supported by the Automotive Division. The event drew 521 registrants with 211 OEM and 68 student participants. The event essentially broke even financially. $17,800 in scholarships were awarded to 23 students. The board agreed that the event was extremely well run and that the keynote speakers and presenters did an excellent job. The success of the virtual event encouraged the idea of providing the virtual component of the conference in place in 2021 even if the in-person event can be restarted.

- Gary Kogowski shared that the 2021 AutoEPCON has been officially cancelled and that the committee has decided not to have a virtual event. The committee did meet with a representative from the Troy Marriott where the AutoEPCON would have taken place and they were impressed by the work to ensure safety for smaller events has the Detroit Section proposing holding a future board meeting and smaller award ceremonies at the venue.

- The 50th Anniversary IAG has been postponed to November of 2021 due to the virus. Updates will be provided as the event draws closer.

- Tom Pickett and Norm Kakarala provided updates on the 2021 ANTEC conference to be held in Denver, CO March 29-31. The event will be conducted as a hybrid event with both a live and virtual component. The live event will be two and one-half days with two weeks of virtual content delivery. The agenda is being finalized and will be published by January 15, 2021. Deadline for papers is November 15, 2020.

- The 2020 Automotive Division Golf Outing was held on September 8 with only 5 foursomes participating. The sponsors were extremely generous despite the low turnout and bad weather, allowing the event to break even financially.

- Bonnie Bennyhoff delivered a concise financial report for the Division which showed $-42K in net revenue in the first quarter of our 20-21 fiscal year. The Division remains viable with over $400K in assets.

- TPO Shanghai originally scheduled for March 23 & 24 2021 has been postponed due to the current Covid-19 situation.

- Teri Chouinard has been nominated for the SPE Honored Service Member Award. Fred Deans and several others from the Automotive Division sponsored her nomination and it was agreed how much Teri's 20 years of service have meant to SPE and the Automotive Division.

- Next meeting: December 7, 2020 5:30-7:30 PM.


# CALL FOR NOMINATIONS

## — HALL OF FAME AWARD — MOST INNOVATIVE USE OF PLASTICS AWARDS

The Automotive Division of the Society of Plastics Engineers (SPE®) is announcing a "Call for Nominations" for its 50th-annual ***Automotive Innovation Awards Gala,*** the oldest and largest recognition event in the automotive and plastics industries. This year's Awards Gala will be held Wednesday, **November 10, 2021** at the Burton Manor in Livonia, Mich. Winning part nominations ***(due by September, 15, 2021)*** in 10 different categories,and the teams that developed them, will be honored with a **Most Innovative Use of Plastics** award. A **Grand Award** will be presented to the winning team from all category award winners. An application that has been in continuous use for 15 years or more, and has made a significant and lasting contribution to the application of plastics in automotive vehicles, ***(nominations due by May 31, 2021)*** will be honored with a **Hall of Fame** award.

A special category has been added for the 50th-annual Automotive Innovation Awards: **INNOVATIVE AUTOMOTIVE INDUSTRY PLASTIC SOLUTIONS FOR COVID-19 PROTECTION,** recognizing the outstanding effort by the plastics and automotive industries to support the international needs for battling this terrible menace that has cost so many so much.

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**HALL OF FAME**

**INNOVATIVE AUTOMOTIVE INDUSTRY PLASTIC SOLUTIONS FOR COVID-19 PROTECTION**

## SPONSORSHIP OPPORTUNITIES

This annual event currently draws over 800 OEM engineers, automotive and plastics industry executives, and media. A variety of sponsorship packages - including tables at the banquet, networking receptions, advertising in the program book, signage at the event and more are available. Contact Teri Chouinard of Intuit Group at **teri@intuitgroup.com.**

For more info and to submit nominations, go to: **www.speautomotive.com/innovation-awards-gala.**

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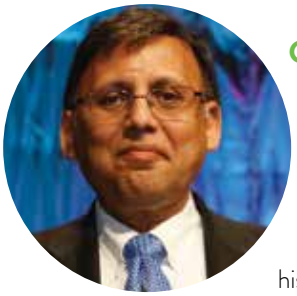
# COUNCILOR'S REPORT

## SPE COUNCIL VIRTUAL MEETING MINUTES
## BY DR. SURESH SHAH

**This report includes Council Virtual meeting on June 30, Chapter Leadership Roundtable – August 21, 2020 & CCOW Virtual Meeting Note - September 25, 2020**



### COUNCIL VIRTUAL MEETING – JUNE 30, 2020

Outgoing President Dr. Landes officially passed the gavel to Dr. Jaime Gómez, as he embarked on his term as SPE President during the Society's Passing of the Gavel and Honors & Awards Presentations. During this virtual event SPE proudly honored the 2020 Fellow and Honored Service Member Award recipients along with announcing who will virtually take home this year's President's Cup. It was a great virtual networking of SPE members and plastics professionals after the presentations.

SPE Chapter Insurance Update Summary for 2020

We have higher (better) coverage than we did in our 2019 policies.

- Commercial (Business) Liability, was $1MM limit per occurrence, now $2MM;
- Management Liability (D&O and Employment Practices*) was $500K per Chapter, now $5MM.
- The deductible increased from $2,500 per occurrence to $5,000, but the coverage is significantly better.
- Employee Theft* coverage was $1,000 per occurrence, now is $1MM.

All other details are similar.

* In these cases, "Employment" also includes Volunteers.

The premium for the 2020 renewal terms is $475 per Chapter, up slightly from the $450 in 2019.

This cost will be added to chapter's regular HQ account statement and netted out from your pass-through dues payments.

### CHAPTER LEADERSHIP ROUNDTABLE – AUGUST 21, 2020

Introduction by Pat Farrey , SPE CEO

Presentation by President-Elect Dr. Jayson Lyon

- Roadmap for Council
- 15 Goals for the Society
- Vision – Inspire
- Mission – How we are going to do that? Sustainability?
- Strategic Planning Process
- Move the needle

Chair of CCOW Dr. Barry

### CCOW VIRTUAL MEETING NOTES – SEPTEMBER 25, 2020

Opening Remarks – Barry Morris

- The new Strategic Plan developed by the EB provides a roadmap around specific goals that Council can contribute towards.
- CCOW will focus on a few goals to discuss and develop concrete actions council can monitor throughout the year. Last council's survey of Council provided guidance for the first 4 goals to discuss during this meeting
- Each goal as an EB champion whom council can work with. Staff is also available to help deliver upon goals.

First four goals were discussed during this meeting.

1. **Enhanced Reputation**

   Discussion on advancing Enhanced Reputation - Council

   Identify and promote a significant, actionable cause in support of SPE's Mission. (EB Champion: Jason Lyons)

   - Our actions should promote recovery and recycling, but also promote the value of plastics.
   - need to spread the word with information packages across schools; benefits and challenges of plastics
   - support broad business objectives that companies can get behind, like sustainability, water use, etc.
   - outreach to plastics professionals as council as companies; companies do not value us enough and thus employees do not see value
   - need more relationship with standards (e.g. ISO) committees.
   - incorporate program with SPE Foundation on consequence of not using plastics

**2. Knowledge Sharing**

**A**. Establish a forward-looking "think tank" to identify emerging technologies which may create programming opportunities. (EB Champion: Gustavo Lidzki)

- President Jaime Gomex explained that the "think tank" has been created through the formation of the new Business Development & Technology (BD&T) Committee chaired by Roger Avakian. This committee was formed by merging the ANTEC, Events and New Technology Committees.
- Pat Farrey (CEO) informed Council that council do participate on many social media formats including Youtube. Links are on the homepage of **4spe.org**.
- Dick Cameron – BD&T has an enormous responsibility. Once they identify a new technology area, the challenge has been getting everyone to buy into it and make part of the SPE brand.

**ACTION:** Council did not solicit volunteers for this goal. Council would like any Councilor who has ideas around this to feed them directly to Roger and the BD&T Committee.

**B.** Organize SPE content from all channels into a top-notch resource which serves stakeholders and generates revenue (EB Champion: Ray Pearson)

Few key comments:

- Dick Cameron – council should use this to generate revenue; good idea to generate using content council already have
- Paul Uglum – tutorials could be an good opportunity. Cited example of SME video cassets.
- Myung Ho – no charge to students is giving away too much. Should have a subscription service.
- Maggie Baumann – Council are missing a lot of opportunities. For example, panel discussions on hot topics and tutorials.

**ACTION:** Barry Morris will work with Ray Pearse to organize a meeting to discuss action plan

**3. Evaluate industry knowledge gaps which represent programming opportunities and solicit SME's to develop programs to address the need.** (EB Champion: Gustavo Lidzki)

Few Key Comments:

- Babli Kapur – With the bimodal age distribution of the work force there is a need for training. With SPE divisions council are council positioned across the value chain to provide content. She volunteered to lead the Council's effort on this goal.
- Jason Lyons – need to think through what a deliverable product looks like. What do companies want – onsite training, videos, etc.
- Maggie Baumann – There are trade group models around continuing education council can look at.
- Paul Uglum - price it right to maximize overall value

**ACTION:** Babli Kapur will set up a meeting with volunteers, Gustavo and BD&T team to discuss action items

**4. Reimage ANTEC into a sustainable model for 2021 and beyond**

Council did not have time to discuss this goal. Council will revisit this at the next CCOW meeting.

**Increase Engagement and Networking**

- Scott Eastman (VP Chapters) gave an overview of new organizational structures that will allow members to network with less engagement/expectations. These include Regional Interest Groups (analogous to SIG's for Sections) and Communities.
- Scott's slides are part of the slide deck attached in this Chain message.
- Kelvin O. – Sections are too large geographically in most cases so there is a need, but not sure RIG's will fill that need.
- Edwin Tamm – Good idea. May need some boundaries for Communities.
- Maggie Baumann – Palisades Section is experimenting with the RIG model, reaching out to other local sections in the area.
- Mercedes Landazuri – Likes the idea. Need to think outside of the box. Plastchicks Podcast has generated new members for SPE

**Closing Remarks – Barry Morris**

- Working with Jaime Gomez to set a schedule of Council and CCOW meetings for the year. Look for a communication soon. Likely 4 CCOW and 2 formal Council meetings (some coincide).
- If you did not volunteer to work on the goals council discussed and would like to, let me know.
- My intent is to monitor progress against these goals throughout the year – so council will revisit each of these at the next meeting and hopefully talk about actual plans and progress against them.

# INTERSOCIETY REPORT

DR. RODRIGO OROZCO,
SPE AUTOMOTIVE DIVISION INTERSOCIETY CHAIR

## POLICY, ELECTRIFICATION, MOBILITY, AUTONOMY AND LIGHTWEIGHTING AWARDS

The Center for Automotive Research (CAR) held the Management Briefing Seminars (MBS) on August 4-5 with sessions that covered a wide range of topics, such as: manufacturing, policy, lightweighting, connected and automated vehicles, sales and production forecasting, mobility, strategy, advanced propulsion development, sustainability, and innovation. Michigan's Lt. Governor Garlin Gilchrist kicked off the event discussing the impact of COVID-19 on the automotive industry, industry workforce and education. In addition, the main topics discussed were policy, electrification, mobility and automation.

The discussion about policy focused on the new USMCA agreement, in particular, the changes that will affect automotive suppliers: i) vehicles must contain at least 75% content from North America, versus just 62.5% under NAFTA; ii) compliance essential that mandates stiff penalties and fines for non-compliance, putting more pressure on auto parts suppliers to understand their entire production process and track rules of origin; iii) 40%-45% of automotive content must be made by workers earning at least $16 per hour; and iv) at least 70% of a producer's steel and aluminum purchases must originate in North America.

Electrification is progressing with automotive OEMs committing to massive investments to develop the technology. The European market faces a rapid change in diesel sales with an increased need of battery electric and hybrid vehicles, mainly driven by tax breaks and the need of OEMs to make up the difference in emission requirements of their entire fleet without the benefit of high fuel-efficient diesel powered vehicles. China extended the tax subsidies for new vehicle registration of electric vehicles until 2022, which drives sales of new electric vehicles and R&D investments.

In terms of mobility, and in particular, mobility as a service, the panel discussed the timeframe that COVID-19 will adversely affect ridership of public transportation, which most agreed to expect to last one to two years. Smart mobility in the urban environment will require redundancy from app-base options to non-app solutions for non-technologically savvy users, including payment options for all mobility solutions, including scooters, bicycles, ride-sharing, bus, train, etc., to go from point A to point B.

The panel discussed that autonomy may be better suited for use in the trucking industry before this technology is offered on self-driving light-duty vehicles. Autonomous vehicles may not be available as quickly as initially thought due to the challenges to develop the technologies required to warrant a secured operation on the roads. Geo-fences facilitate the deployment of autonomous vehicles and services in secured areas; the current trend is expansion to larger zones and adoption by more cities around the world.

The 8th Annual Altair Enlighten awards' winners have been announced and presented at the CAR MBS on August 4th, 2020. The awards honor the greatest achievements in vehicle weight savings, in addition to other parameters such as cost reduction, improved performance, part consolidation and applicability to other vehicle programs. Carla Bailo, president and chief executive officer at CAR said "design optimization is critical for every new product in the automotive industry and lightweighting is a key component. We are honored to collaborate with Altair in acknowledging these design innovations in the automotive sector". The winners of the four categories are:

- **Full Vehicle winner:** Harley-Davidson LiveWire electric motorcycle. This motorcycle has an improved energy capacity of 90% while increasing the ratio of energy capacity to vehicle mass by 60% compared to internal combustion powered bikes. Glen Koval, general manager of engineering at Harley-Davidson, explained at the ceremony "We were able to keep vehicle weight relatively neutral. Our chassis is the lightest chassis we have ever designed at Harley-Davidson. We did bring in composites around many of the other components that don't require chassis stiffness – fenders, body panels, most of the brackets are of different composite materials."
- **Module winner:** 2021 Toyota Sienna third row two-occupant seat back. An industry first, Toyota created an injection molded back-frame with no molded reinforcement. The design consolidated 15 components to one part with one injection, reduced costs and mass by 15% and 30%, respectively, and improved safety performance by two times.
- **Enabling Technology winner:** Mubea glass fiber-reinforced polymer tension leaf spring. This innovative design offers weight savings of up to 75% compared to a standard multi-layer steel spring.
- **Future of Lightweighting winner:** Marelli suspension steering knuckle. Marelli's design used advanced sheet compression molding to provide 25% mass savings compared to the aluminium version used on the Jeep Compass and a 50% savings compared to the cast iron version.

Despite the vehicle sales reduction due to the global pandemic, the automotive supplier R&D spending remains high as companies develop innovative technologies, with focus on electrification and automation. Electrification is also bringing a challenge for charging stations with multiple chargers that will require local grid infrastructure along with local storage or innovative technologies to balance the peak demand of fast charging stations. Fast charging stations of 300kW may cause a temporary electrical grid demand equivalent to about 250 homes that each consume on average 1.2kW per hour. We are in an exciting time to offers plastic materials that meet the new requirements of existing and new applications for diverse mobility solutions and electrification.

AUTOMOTIVE

# TECHNICAL REPORT

ETHAN WATT [1,2,%], MOHAMED ABDELWAHAB[1,$], MICHAEL SNOWDON[1,2], AMAR K. MOHANTY[1,2,*], HAMDY KHALIL[3], MANJUSRI MISRA[1,2]

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[2] School of Engineering, Thornbrough Building, University of Guelph, Guelph, ON, N1G 2W1, Canada

[3] Woodbridge Foam Corporation, 4240 Sherwoodtowne Blvd., Mississauga, ON, L4Z 2G6, Canada

[$] On leave from the Department of Chemistry, Tanta University, Tanta, 31527, Egypt

## ETHAN WATT

is an undergraduate Nanoscience student in his fourth year at the University of Guelph. Within this field, his studies focus mainly on physical chemistry and material science. His area of focus at the Bioproducts Discovery & Development Centre is composite research, with particular interest in the incorporation of biocarbon and nanofillers into polymeric matrices.

# INFLUENCE OF SOY HULL BASED BIOCARBON AND GRAPHENE NANOPLATELETS ON THE PERFORMANCE OF POLYPROPYLENE BIOCOMPOSITES FOR AUTOMOTIVE APPLICATIONS

## ABSTRACT

Polypropylene (PP) shows wide usage in the automotive industry, owing to its strength, chemical resistance, and processing ease. The movement away from petroleum-dependence has led to research into sustainable fillers to partly replace the PP matrix, with biocarbon (BioC) being of particular interest. However, this filler commonly diminishes mechanical strength, and to address this the compatibilizer maleic anhydride grafted polypropylene (MA-PP), as well as the nanomaterial graphene nanoplatelets (GnPs), were incorporated as a second filler. It was observed that the optimal formulation was PP/17%BioC/3%MA-PP/3%GnP, which led to mechanical and thermal properties beyond that of neat PP. Flexural strength and modulus were raised by around 28 and 59%, respectively, owing to the stiffness of the filler particles and restriction of chain mobility. This restriction in chain mobility had the added benefit of enhancing the heat deflection temperature by 28%, as well as the dimensional stability, as observed through a decrease in the coefficient of linear thermal expansion by around 17% as compared to neat PP. Overall, these biocomposites provide a direction to the improvement of PP properties while simultaneously decreasing its petroleum content, making them ideal for automotive applications.

## INTRODUCTION

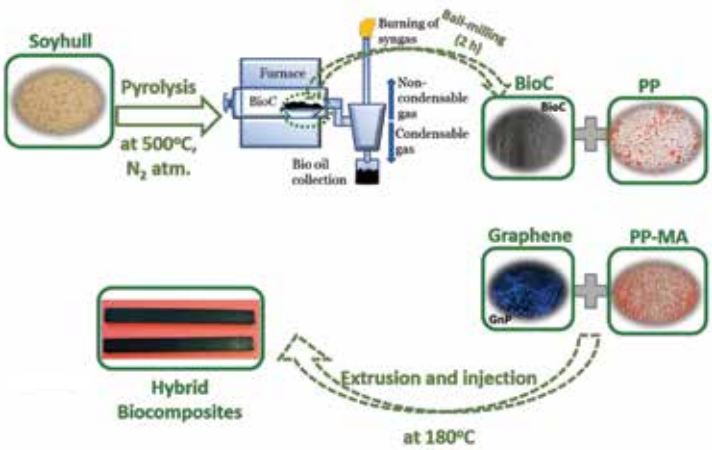
Polypropylene (PP) is widely used in automotive applications due to its chemical and heat resistance, low density, and comparatively strong mechanical properties, with usage in dashboards, bumpers, and hoods [1]. However, PP is a petroleum-based polymer that is typically either discarded at landfills or incinerated and as such contributing to the global issue of climate change [2]. A variety of publications have analyzed the effect of biocarbon (BioC) addition as a biofiller to a PP matrix due to its cost-effectiveness, low density compared to conventional fillers (glass fiber and talc), and ability to increase the biocontent of composites in a petroleum-dominated field [3]. It has been found that high-temperature pyrolysis of waste feedstock to produce BioC is more compatible with a PP matrix, but lower temperatures have improved yield and thus are more realistic for industrial applications [4,5]. This biofiller commonly leads to drops in mechanical strength, but its high thermal stability can be seen to enhance the thermal properties of PP composites [4,6].

To account for worsened adhesion between the PP matrix and BioC, the compatibilizer maleic anhydride-grafted-polypropylene (MA-PP) has been found to be efficient [7,8]. To further restore any lost mechanical strength of the composites, incorporation of nanofillers like graphene nanoplatelets (GnPs) have received increasing attention [9-11]. GnPs lack the presence of functional groups, making them compatible with nonpolar PP matrices, as demonstrated through a study by Jun et al. [9]. This study found that smaller particle diameters (< 15 μm) had improved dispersion within the matrix, leading to stronger stress transfer interactions. However, this nanomaterial often suffers from agglomeration due to strong π-π and *van der Waals* interactions that serves to limit its effectiveness [10].

This study is based on our recent work, which was the first study to characterize PP composites containing both BioC and GnPs [11]. The goal of this research was to develop cost-effective composites at an elevated bio content that enhanced the mechanical and thermomechanical properties beyond that of neat PP. It is expected that the hybridization of BioC's thermal stability and the mechanical strength of GnPs have the potential to accomplish this. A brief characterization of the soy hull BioC has been performed, along with the morphological (SEM and TEM), mechanical (flexural properties), and thermomechanical characterization of the fabricated composites.

## EXPERIMENTAL

The process of biocomposite fabrication has been outlined in Scheme 1. The PP (grade PP1350N) was purchased directly from Pinnacle Polymers (USA), while MA-PP (Fusabond P353) was purchased from Dupont (USA), and the GnPs (grade M5) were purchased from XG Sciences Inc. (Lansing, MI, USA). The biocarbon powder was prepared through pyrolysis of soy hull (supplied by Nieuwland Feed, Drayton, ON, Canada) at 500°C with a heating rate of 7.5°C/min and residence time of 1 h in a GLO Carbolite 10/11-1G pyrolyzer with an inert nitrogen atmosphere. Following pyrolysis, the biocarbon was collected and ball-milled for a total of 2 hr. Materials apart from the hydrophobic PP pellets were dried prior to pyrolysis, and then mixed according to the specified composite formulation. This material then underwent extrusion and injection using a Micro-compounder DSM (Netherland) at 180°C to fabricate flexural bars conforming to ASTM D790 standards. These fabricated composites then underwent mechanical and thermomechanical testing to examine their material properties. Thermogravimetric analysis coupled to Fourier transform infrared spectroscopy (TGA-FTIR) was applied under inert gas ($N_2$ gas) with a heating rate of 20 ml/min for soy hull powder, using a TA 5500 connected to a FTIR Nicolet iS20 from Thermoscientific, USA. Scanning electron microscopy (SEM) of the cryofracture samples was accomplished using a SEM Desktop Phenom ProX Microscope (Netherlands) at 15 kV. Transmission electron microscopy (TEM) of the hybrid composite was analyzed using a TEM 2010F Joel Microscope at 200kV. Heat deflection temperature (HDT) measurements of the composite samples were performed with a load 0.455 MPa using TA Instruments (TA Q800) according to ASTM 648 standard. The coefficient of linear thermal expansion (CLTE) of the PP composite samples were analyzed in the flow direction (FD) with a force 0.05 N and heating rate of 5 oC.min-1 using TA Instruments (TA Q400).




*Scheme 1: Preparation of PP hybrid biocomposites.*

## RESULTS AND DISCUSSION

### TGA-FTIR ANALYSIS OF SOY HULL GASES

To determine the environmental impact of the pyrolyzed BioC for industrial-scale applications, TGA-FTIR analysis was conducted to examine the release of volatile compounds. The gas products start to evolve at around 253°C and finished at around 600°C, as observed in Figure 1. The major volatile shifts identified included water/alcohols, hydrocarbons, carbon monoxide, carbonyl compounds, ether compounds, and carbon dioxide. The strongest absorption peak correlated to carbon dioxide, which constituted over 64% of the released volatiles during the pyrolysis process. There were other minor contributions by carbonyl compounds (~15%), ether compounds (~8%) and water/alcohols (~6%). A promising aspect for the usage of soy hull feedstock is that carbon monoxide emissions from the pyrolysis process are very low (~1%).

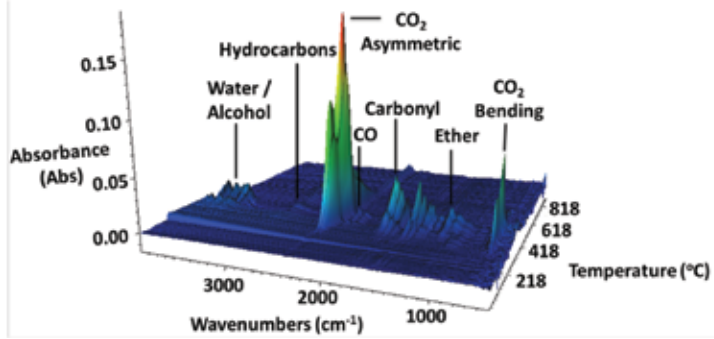



*Figure 1: TGA-FTIR generated soy hull 3D surface plot, with relevant released volatile compounds indicated [11].*

### COMPOSITE MORPHOLOGY

To examine the effect of filler addition on a PP matrix, scanning electron microscopy (SEM) analysis was employed to image the cryo-fracture interface. As expected, based on previous studies, the addition of 20 wt.% BioC in Figure 2a showed clear signs of phase separation and post-fracture particle pull-outs. This arose due to an absence of interactions between the polar BioC filler and non-polar polymeric matrix, and was partly recovered via compatibilizer incorporation, as identified in Figure 2b. It was determined based on mechanical and thermomechanical characterization that the optimal GnP incorporation was at 3 wt.%, with a composite formulation of PP/BioC/MA-PP/GnPs at loadings of 77/17/3/3 wt.%. This composite is visible in Figure 2c, and due to the 6-8 nm thickness of individual GnP layers, the identified graphene layers constitute a multitude of stacks that appeared poorly dispersed within the PP matrix. This agglomeration was attributed to intermolecular forces and residual moisture content within the nanomaterial. However, due to the nanoscale of this filler, it is more appropriately characterized through transmission electron microscopy (TEM), as in Figure 2d. This further reinforced the outcomes seen through SEM imaging, where agglomeration of nanoplatelets were recognized.

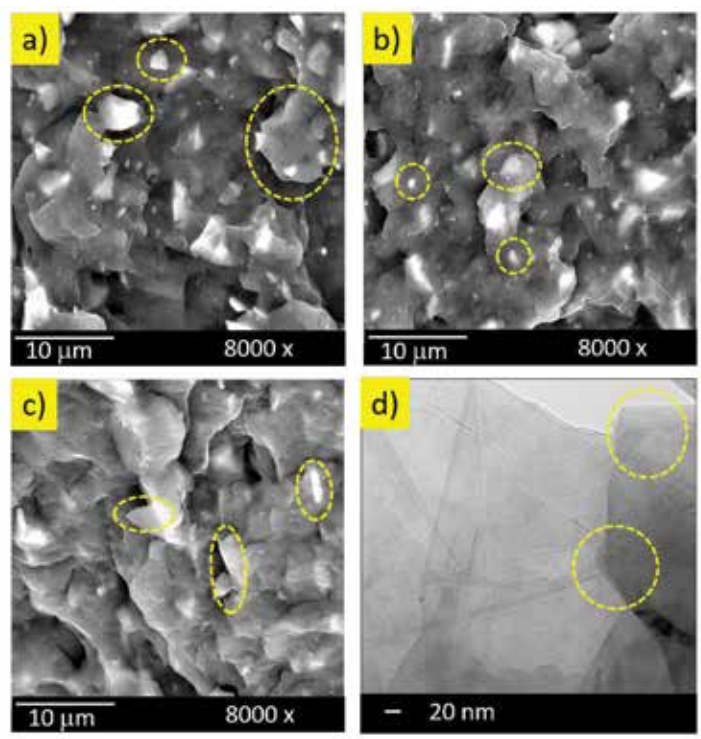



*Figure 2: SEM micrographs of cryo-fractured composites: a) PP/20%BioC, b) PP/20%BioC/3%MA-PP and c) PP/17%BioC/3%MA-PP3%GnP. d) TEM micrographs of PP/17%BioC/3%MA-PP3%GnP [11].*

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## FLEXURAL PROPERTIES

Flexural properties of neat PP and the fabricated biocomposites can be seen in Figure 3. Surprisingly, it was observed that the addition of BioC led to an improved flexural strength, unlike tensile strength as observed in a previous study [11]. Compatibilizer addition led to an increase in flexural strength due to improved bonding within the matrix, which can resist elastic deformation. Even a minor addition of GnPs led to a comparatively large increase in strength. These improvements in flexural strength may be due to the stiffness of both the GnP sheets and BioC particles. BioC had the benefit of being well dispersed within the matrix, and its particles aided deformation resistance while under load. In comparison, natural GnPs are far stiffer than BioC due to their two-dimensional hexagonal lattice structure, meaning even small incorporations serve to enhance mechanical properties [12]. The modulus also saw improvement through filler addition, as the stiff particles restricted mobility of the PP matrix. BioC and GnP have both been seen to have this effect on PP, while MA-PP had little effect on modulus [13,14]. As seen, the fabricated biocomposites have a flexural strength and modulus that has been improved by up to 28 and 59% as compared to neat PP, respectively.

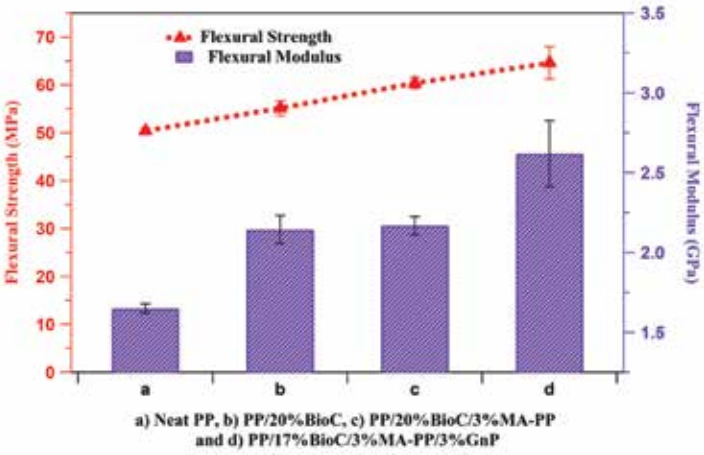


*Figure 3: Flexural properties of PP hybrid biocomposites.*

# THERMOMECHANICAL CHARACTERIZATION

## HEAT DEFLECTION TEMPERATURE (HDT)

HDT, being a description of heat resistance, is an important property for automotive composites as thermal stability must be maintained over extended use in warm environments. The HDT values of all fabricated biocomposites can be observed in Figure 4, and neat PP saw a large increase by 21°C through BioC addition. This derives through PP chain mobility restrictions as deformation is thus hindered, and this effect has been observed elsewhere [6,14,15]. The rubbery nature of MA-PP led to a subsequent decrease in HDT, but was improved through further chain restrictions from GnP addition. This is a very promising property of the biocomposites, with the optimal formulation leading to a 28% increase in HDT.

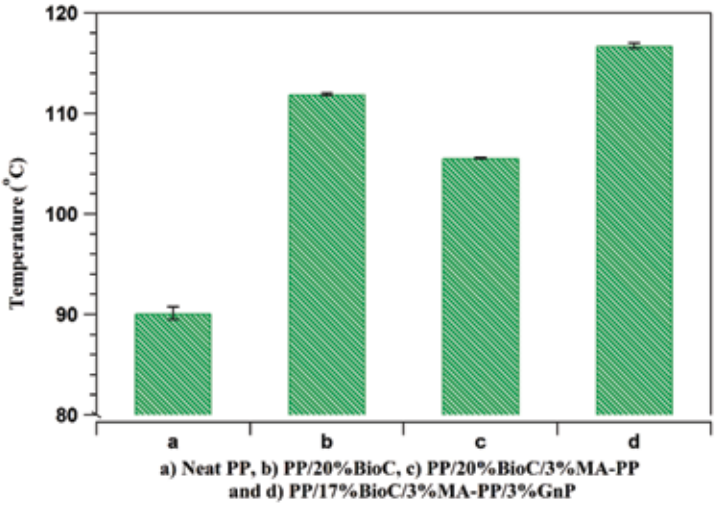


*Figure 4: HDT of PP hybrid biocomposites.*

## CLTE ANALYSIS

CLTE is another property that indicates dimensional stability of the composites, as it describes how material size changes at varying temperatures. A high CLTE is not desirable in automotive applications. There are two major regions of the CLTE, being glassy (measured from -30 to 30°C) and rubbery (-30 to 100°C) states. As seen in Figure 5, BioC addition (20 wt.%) resulted in a reduction in the CLTE value in the rubbery state by 18.5% as compared to neat PP, which underwent another 7.6% decrease upon GnP inclusion. It can be concluded from this that the well-dispersed BioC particles served to hinder polymeric movement, which supports HDT data and corresponds to findings by other studies [1,13,15]. While not having a major impact in the rubbery state, MA-PP resulted in a minor reduction in CLTE in the glassy state, which was attributed to improvements in bonding between the biofiller BioC and the matrix. GnPs have a naturally low coefficient of thermal expansion and a high surface area, which serves to explain the improvements it had on CLTE [14]. The optimal biocomposite had a CLTE that was reduced by 25% as compared to neat PP, indicating that it has a higher dimensional stability.

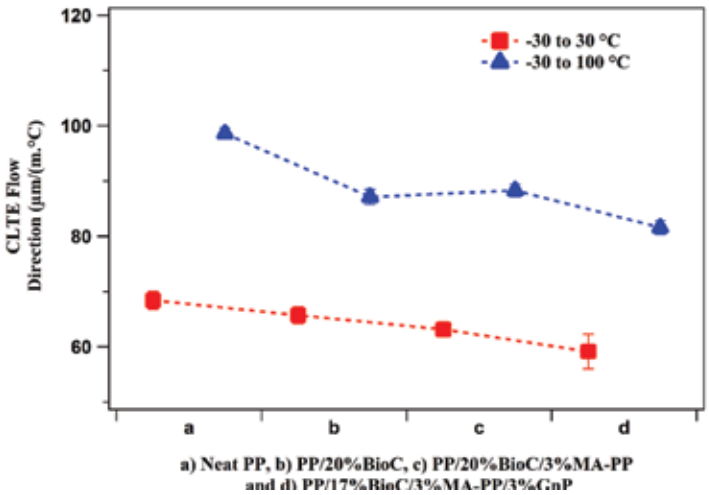


*Figure 5: CLTE of the PP hybrid biocomposites in the flow direction.*

## SUMMARY AND NEXT STEPS

BioC and GnP was successfully incorporated into a PP matrix to form biocomposites, with an optimal formulation of PP/17%BioC/3%MA-PP/3%GnP. Poor interaction between the biofiller and PP matrix was improved through compatibilizer incorporation, while GnPs showed signs of agglomeration due to intermolecular forces. Despite this, the biocomposites still saw significant increases in both mechanical and thermomechanical properties. Flexural strength and modulus improved beyond neat PP by 28 and 59%, owing to the stiffness of both BioC and GnP. The chain restrictions imparted through filler addition led to a subsequent improvement in HDT by up to 28%, as well as a stronger dimensional stability as measured through CLTE analysis. These biocomposites show great promise for automotive applications, as they have improved mechanical strength, as well as thermal stability for heat-intensive applications at an elevated biocontent. Based on the results obtained, these composites would benefit through future study on GnP dispersion methods. Agglomeration partially limited the benefits GnPs can provide on both mechanical and thermal properties, and proper dispersion could lead to superior biocomposites.

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