



WINTER 2021
VOL 50, ISSUE 2

AUTOMOTIVE PLASTICS NEWS

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

SPONSORED BY



AUTOMOTIVE
INNOVATION AWARDS
COMPETITION & GALA
HONORING THE BEST IN AUTOMOTIVE PLASTICS

SPE® ANNOUNCES “CALL FOR NOMINATIONS” FOR 50TH ANNUAL AUTOMOTIVE INNOVATION AWARDS COMPETITION & GALA

“This year, in addition to celebrating ‘50 Years of Plastics Innovation,’ we will showcase how polymer technologies enabled solutions for battling COVID-19. Protective masks, face shields, clothing; medical supplies; ventilators and more are made possible or enhanced with plastics. Our society benefits from the ability of plastics to deliver form and function in unique ways through the creativity of automotive engineers and designers.”

— Jeffrey Helms, global automotive director, Celanese Corp.

Continued on page 4



50 YEARS OF
PLASTICS INNOVATION

NOVEMBER 10, 2021



A TRIBUTE TO OUR DEAR FRIEND,

Nippani Rao

continued on page 4-5



“Nippani was a kind, humble and warm hearted friend with a calming smile.” – **Keith M. Siopes**

Nippani and I had at least 3 US Patents and Nippani had an RTM Patent for molding body panels (Patent number: 5414037).

Nippani was an excellent Mentor to Chrysler Design Engineers and provided State of the Art material innovations. An original Viper Team member. – **Roy Sjöberg**

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AUTOMOTIVE

MEETING SCHEDULE & SPECIAL EVENTS CALENDAR

TPO Abstracts Due April 9, 2021

ACCE Abstracts Due April 16, 2021

SPE Auto. Div. Board Meeting
via Webex – Contact Us for Meeting Link 5:30 - 7:30 p.m.
April 19, 2021

ANTEC® 2021 THE HYBRID EDITION
Starts May 5th, 2021

SPE Auto. Div. Board Meeting
via Webex – Contact Us for Meeting Link 5:30 - 7:30 p.m.
June 14, 2021

ACCE Papers/Presentations Due June 18, 2021

TPO Presentations Due July 9, 2021

SPE Auto. Div. Board Meeting
via Webex – Contact Us for Meeting Link 5:30 - 7:30 p.m.
August 16, 2021

26th-Annual SPE Automotive Division Golf Outing
Fieldstone Golf Course All Day
Auburn Hills, MI USA September 7, 2021

21st-Annual Automotive Composites Conference and Exhibition
Suburban Collection Showplace All Day
Novi, MI USA September 8-10, 2021

IAG Parts Nominations Due September 9, 2021

22nd-Annual TPO
Detroit Marriott Troy All Day
Troy, MI USA October 3-6, 2021

SPE Auto. Div. Board Meeting
via Webex – Contact Us for Meeting Link 5:30 - 7:30 p.m.
October 18, 2021

50th-Annual Innovation Awards Gala
Burton Manor 4:30 - 11:00 p.m.
Livonia, MI USA November 10, 2021

SPE Auto. Div. Board Meeting
via Webex – Contact Us for Meeting Link 5:30 - 7:30 p.m.
December 6, 2021

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



Dear Automotive Division of the Society of Plastics Engineers Friends –

The COVID-19 pandemic has had a tremendous impact on our events and networking. At this time, we can reasonably hope that the vaccine roll out will reach many of us by summer, for an end to the

COVID-19 pandemic by 2021. We are sincerely grateful for your unwavering support and dedication concerning the activities of the Automotive Division especially during this uncertain time. A big thank you as well to all our directors, committee chairs and volunteers for their service and time spent to make the SPE Automotive Division so strong.

The Automotive Division of the Society of Plastics Engineers has recently announced a “Call for Nominations” for its 50th Automotive Innovation Awards Gala, the oldest and largest recognition event in the automotive and plastics industries. There is a new category this year to highlight how automotive OEMs and suppliers adapted their processes, materials, or business to support the international needs for battling COVID-19.

To allow for some local in-person presenters and attendees while also accommodating those who wish to present or participate remotely from different part of the world, the SPE TPO Automotive Engineered Polyolefins Conference will be a hybrid of in-person, virtual, and live streaming. The conference will be held at the Troy, Michigan Marriot Hotel from October 3rd-6th, 2021.

The SPE Automotive Composites Conference & Expo (ACCE) team has also recently announced its call for papers for their 21st annual event on September 8th -10th, 2021. “Composites: Driving Value by Reducing Weight and Costs & Increasing Performance,” is the theme for this year’s event. The ACCE team is planning on having an in-person event at the Suburban

Collection Showplace, Novi, MI. If necessary, the team will transition to a virtual event like they did in 2020. The team may have a virtual component as part of the ACCE 2021 event. The team is exploring this option to allow those who cannot attend in-person to participate.

Since the SPE Auto EPCON is heavily weighted on networking and interaction of attendees, we are all utterly heartsick that this event has been canceled. The team will monitor the pandemic situation with respect to re-scheduling the conference.

For more details on these and future events, please go to our new website <https://speautomotive.com/> and go to the upcoming events link – we hope to see you there.

At any time, if you have ideas on how to make our section 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

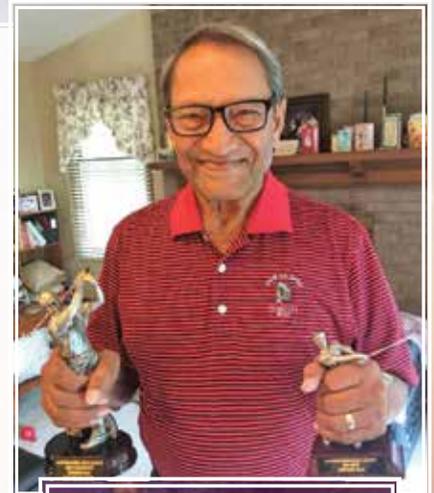




Nippani Rao

*An Industry Leader,
a Selfless Volunteer, a True Friend*

We are saddened to report that **Nippani Ra**, of Farmington Hills, MI, entered eternal life early Tuesday evening, January 19, 2021. He was 81. He married Joan M. (Burns) on February 28, 1969, and together they enjoyed nearly 52 years of marriage. In addition to his wife, Nippani is survived by three sons, David, Eric, and Stephen (Michelle); and siblings, Rama Nippani and Lakshmi Veena.



Nippani was a pillar in the automotive industry. He was a long time Board of Director for the SPE Automotive and SPE Composites Divisions and SPE Detroit Section, where he contributed many years of thoughtful and responsible leadership. He was a chair of the SPE Automotive Lifetime Achievement and Automotive Innovation Hall of Fame Awards committees and served as a judge on the Blue-Ribbon Judging committee for the SPE IAG and Automotive Composites Conference & Exposition Part Competition.



During his industry tenure, Nippani served as:

- **President, RAO Associates** 2009 – 2021
 - **Technology Manager, Asahi Kasai, LLC** 2008 – 2010
 - **Materials Engineering Supervisor, Chrysler LLC** 1986 – 2008
- Nippani's engineering responsibility included the award-winning Dodge Viper Body innovations with RTM (Resin Transfer Molding). He has numerous material patents. Nippani greatly valued SPE and made sure Chrysler stayed involved in the Society.



His formal education includes:

- Xavier University, MS Na MBA, Chemical Engineering and Marketing 1966 – 1973
- University of Cincinnati, Master's Degree, Chemical Engineering

Nippani greatly valued SPE and made sure Chrysler stayed active and involved. **The Automotive and Composites Divisions will be honoring Nippani at the SPE Automotive Innovation Awards Gala** on November 10, 2021 at the Burton Manor in Livonia, Michigan.



Many of Nippani's friends and associates have asked to express their thoughts and remembrances of Nippani. Here are a few of them:

"Nippani's professional commitment to advancing the use of polymers in automotive, his contribution and leadership at the SPE, mentoring and guiding the next generation and his personal warmth, kindness and friendship will be missed" – **UV, Sabic**

"In addition to belonging to the SPE Automotive Division, Nippani was also an active member of the SPE's Composites Division. (In fact, he recommended that I also join the Composites Division BOD.) One of our CD members, Tim Simco, had recently retired because of failing health issues. (BTW, Tim was instrumental in the alignment of the Automotive Division into the ACCE in 2001.) The Composites Division had nominated Tim for Honored Service member, which is normally awarded at the spring ANTEC. Nippani called me and thought that Tim wouldn't be around to wait for next ANTEC, so he thought we could convince the HSM committee to send us the award "plaque" and we could present it to Tim at his home in Indiana long before the next ANTEC. Nippani made it happen! We gathered some SPE local members and the HSM plaque, hopped in a car and drove to Tim's home in Indiana, where Nippani lead an impromptu HSM presentation ceremony for Tim. Needless to say, it really cheered Tim up. (It made us feel pretty good as well.)



I think this act of kindness and thoughtfulness about Nippani speaks volumes about his character and feelings for his friends and coworkers. I will always remember the Nippani as a very good friend." – **Fred Deans**

"Nippani was a very close friend and SPE colleague since 1990. I will always cherish the beautiful memories working together at several SPE events with his amazing dedication. I will miss going out to a leisure lunch at his favorite Indian restaurant "Biryani Express". He will be greatly missed but his kindness, smile, good attitude and gentle spirit will be remembered forever. With love and deepest sympathy as we remember a very dear friend". – **Dr. Suresh Shah**

Thank you for sharing the news, I am still surprised. I worked with Nippani in the past and keep very good memories of him. Visiting FCA with him was like walking with a celebrity! He will be missed. My thoughts and prayers to his family. – **Rodrigo Orozco**

So sorry to hear this news...

It's a real loss to plastic community and the industry. He will certainly be missed. – **Dhanendra Nagwanshi**

So sad to hear this news. I did not know him well, but his dedication to the SPE BOD was obvious and important at SPE events. – **Jeremy Lee**

I was surprised and saddened to hear about the passing of Nippani. He was a core member of the SPE Automotive board for many years, an integral part of the team and a good friend to so many of us. I enjoyed our discussions about his career, especially his time working at the DeLorean Motor Company. His experience, insight and kind disposition will be missed. While I'm glad we will be honoring Nippani at the next SPE Innovation Awards, I will miss his presence at our future events. Godspeed, my friend. – **Mark Lapain**

We were fortunate as a Board of Directors to have Nippani with us for so long. His drive, ambition, and passion for making our Society better was evident every day. On the personal side though, he would always ask how things were and how your family was doing. For me, it was about Tony who was at Purdue back then. "How's Tony doing? Purdue is a great school." I will miss his friendship, smile and conversation. He left us much too soon.. – **Brian Grosser**

Nippani was one of the most genuinely kind and supportive members of the SPE Automotive Division. He was a Co-Chair of the SPE Automotive Innovation Hall of Fame and Lifetime Achievement Awards, and an SPE Automotive Innovation Awards Blue Ribbon Judge and a Judge for the ACCE Part Competition for many years. He was a leader on numerous other SPE committees and received the "Honored Service Member" award from SPE – he was a pillar in the industry. Nippani was always so nice to work with and very helpful to me personally. I will miss him dearly and always remember his warm smile. – **Teri Chouinard**



MOST INNOVATIVE USE OF PLASTICS AWARD NOMINATIONS – DUE SEPTEMBER 15, 2021

NEW CATEGORY FOR 2021:

Automotive Plastics Industry Solutions for COVID-19

This category will highlight how automotive OEMs and suppliers adapted their processes, materials, or business to support the international needs for battling COVID-19

ADDITIONAL CATEGORIES INCLUDE:

**Additive Manufacturing • Aftermarket & Limited Edition/Specialty Vehicles • Body Exterior • Body Interior
• Chassis/Hardware • Environmental • Materials • Powertrain • Process/Assembly/Enabling Technologies • Safety**

HALL OF FAME AWARD

The Top 5 Most Innovative Hall of Fame Award Winners over last 39 years will be recognized

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 (established in 1970) in the automotive and plastics industries. This year’s Awards Gala will be held **Wednesday, November 10, 2021** at the Burton Manor (www.burtonmanor.net) in Livonia, Mich. Winning part nominations (**due by September 15, 2021**) in 11 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. This year’s program will include a new category – **“Automotive Plastics Industry Solutions for COVID-19”** – highlighting how automotive OEMs and suppliers adapted their processes, materials, or business to support the international needs for battling COVID-19. Additional categories include: Additive Manufacturing, Aftermarket & Limited Edition/Specialty Vehicles, Body Exterior, Body Interior, Chassis/Hardware, Environmental, Materials, Powertrain, Process/Assembly/Enabling Technologies, and Safety.

To further commemorate **“50 Years of Plastics Innovation,”** the Innovation Awards Gala planning committee is working on special events to celebrate. One of the events will be a special Hall of Fame (HOF) Award honoring the top 5 most innovative HOF winners since the category was established in 1983. Instead of picking a single Hall of Fame Winner for 2021, the HOF committee will determine the top 10 from the previous 38 winners - from 1983 to 2019. Then, the HOF committee will select the top 5 to be honored with special recognition at the event. The criteria for a

HOF award is that the nomination be in use for at least 15 years and be: game changing; very successful worldwide; innovative in materials, process and application; and still being used. The HOF committee consists of engineers, managers, executives, technical experts, SPE Fellows, SPE Honored Service Members and automotive industry technical experts having served at least 30 plus years in the industry. Nominations must be submitted online via: <https://speautomotive.com/wp-content/uploads/2021/01/2021-SPE-Innovation-Awards-Program-Part-Nomination-Form-V12.pdf>

“We’re really looking forward to celebrating a half century of automotive advancements enabled by innovative plastics technologies,” said Jeffrey Helms, global automotive director, Celanese Corp., who returns as the 2021 SPE Automotive Innovation Awards chair. “Unfortunately, we had to postpone the 2020 event due to CDC (Center for Disease Control) recommendations for social distancing as a result of the COVID-19 pandemic,” added Helms. “This year, in addition to celebrating **‘50 Years of Plastics Innovation,’** we will showcase how polymer technologies enabled solutions for battling COVID-19,” continued Helms. “Protective masks, face shields, clothing; medical supplies; ventilators and more are made possible or enhanced with plastics,” said Helms. “Our society benefits from the ability of plastics to deliver form and function in unique ways through the creativity of automotive engineers and designers.”

The program will include advancements in safety, including seat belts, air bags, and sensing devices – all enabled by advancements in plastics technology. The environmental benefits made possible with and by plastics, including improved fuel efficiency, reduced carbon emissions

and the growth of automotive innovations with natural and recycled materials for improved sustainability will also be highlighted. Notable innovations in plastics enabled design and styling will also be honored.

Since 1970, the **SPE Automotive Innovation Awards Competition** has highlighted the positive changes that polymeric materials have brought to automotive and ground-transportation industries, such as weight and cost reduction, parts consolidation, increased safety, and enhanced aesthetics and design freedom. At the time the competition started, in 1970, many OEM designers and engineers thought of plastics as inexpensive replacements for more “traditional” materials. To help communicate that plastics were capable of far more functionality than their typical use as decorative knobs and ashtrays indicated, members of the board of directors of SPE’s Automotive Division created the competition to recognize successful and innovative plastics applications and to communicate their benefits to OEMs, media, and the public.

Over the years, the competition drew attention to plastics as an underutilized design tool and made industry aware of more progressive ways of designing, engineering, and manufacturing automotive components. From its humble beginnings, the competition has grown to be one of the most fiercely contested recognition events in the automotive and plastics industries. Today, polymeric materials are no longer substitutes for more expensive materials, but rather are the materials of choice in hundreds of different applications throughout the vehicle. Without plastics, many of the auto industry’s most common comfort, control, and safety applications would not be possible.

During the competition phase of the event, dozens of teams made up of OEMs and suppliers work for months to hone submission forms and presentations describing their part, system, or complete vehicle module to support claims that it is the year’s **“Most Innovative Use of Plastics.”** To win, teams must survive a pre-competition review and two rounds of presentations before industry and media judges.

There is no cost to nominate parts, however, nominations that are accepted into the competition need to be presented (in person or via webinar) by their nominating teams during the first round of Automotive Innovation Awards Competition judging, September 23– 24, 2021 in Auburn Hills, Michigan. Finalists from that round advance to a second presentation before a panel of Blue Ribbon judges made up of media, retired chief engineers, and other industry experts on October 1, 2021 (also in Auburn Hills, Mich.) Winners of each part category, the Grand Award, Hall of Fame, and Lifetime Achievement winner will all be honored during the **Automotive Innovation Awards Gala** on November 10, 2021. This annual event currently draws over 800 OEM engineers, automotive and plastics industry executives, and media. Funds raised from the event are used to support SPE educational programs including technical seminars and conferences, which help educate and secure the role of plastics in the advancement of the automobile.

The mission of SPE is to promote scientific and engineering knowledge relating to plastics worldwide and to educate industry, academia, and the public about these advances. SPE’s Automotive Division is active in educating, promoting, recognizing, and communicating technical accomplishments in all phases of plastics and plastic-based composite developments in the global transportation industry. Topic areas include applications, materials, processing, equipment, tooling, design, and development. For more information about the SPE Automotive Div., see <https://speautomotive.com/>. For more information on the Society of Plastics Engineers, see www.4spe.org.

ATTN: EDITORS: A large collection of SPE Automotive Division digital photography is available for download at: <https://www.flickr.com/photos/speautomotive/albums/with/72157673717033072>

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Shown above are members of the team that developed the 2019 Grand Award and Body Exterior category winner – the Composite Pickup Box on the 2020 GMC Sierra LD FST pickup from General Motors Co.



**AUTOMOTIVE
INNOVATION AWARDS
COMPETITION & GALA**
HONORING THE BEST IN AUTOMOTIVE PLASTICS

50

50 YEARS OF PLASTICS INNOVATION



NOVEMBER 10, 2021

**CALL FOR NOMINATIONS
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.

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.

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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- ADDITIVE
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- BODY EXTERIOR
- BODY INTERIOR
- CHASSIS/HARDWARE
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- MATERIALS
- PROCESS, ASSEMBLY &
ENABLING TECHNOLOGIES
- POWERTRAIN
- SAFETY
- INNOVATIVE AUTOMOTIVE
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AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION

Novi, MI • September 8-10, 2021

Presented by SPE Automotive and Composites Divisions

WORLD'S LEADING AUTOMOTIVE COMPOSITES FORUM



BY TERI CHOUINARD, SPE AUTOMOTIVE DIV. COMMUNICATIONS CHAIR

SPE® ACCE ANNOUNCES CALL FOR PAPERS, SPONSORS & EXHIBITORS FOR 2021 EVENT

COMPOSITES: DRIVING VALUE BY REDUCING WEIGHT AND COSTS & INCREASING PERFORMANCE

The SPE Automotive Composites Conference & Expo (ACCE) team is announcing its Call for Papers, Sponsors & Exhibitors for their 21ST annual event September 8 - 10, 2021 at the Suburban Collection Showplace in Novi, Michigan located in the Detroit suburbs. “Composites: Driving Value by Reducing Weight and Costs & Increasing Performance” is the theme for the 2021 event. The ACCE features technical sessions, panel discussions, keynotes, and exhibits highlighting advances in materials, processes, and equipment for both thermoset and thermoplastic composites in a wide variety of transportation applications. Networking breakfasts, lunches, and receptions enhance the value of the event that attracts over 800 attendees from across the globe. The Automotive and Composites Divisions of the Society of Plastics Engineers (SPE®) jointly produce the ACCE to educate the industry about the benefits of composites in transportation applications.

The 2021 ACCE will be co-chaired by 2018, 2019 and 2020 ACCE Technical Program co-chair Dr. Leonardo Simon, professor, Chemical Engineering at University of Waterloo; returning ACCE 2020 co-chair Dr. Xiaosong Huang, lab group manager of Polymer Composite Systems in GM Global Research & Development, General Motors Company; and Dr. Khaled W. Shahwan, senior

technology leader – Advanced Technology & Pre-Development Programs, Stellantis. “We’re planning on ACCE 2021 being a live in-person event enabling personal networking with key automotive OEMS, top tier suppliers and other industry leaders which is an ACCE hallmark,” said Simon. “As our company continues to incorporate lightweighting, structural strength and innovative design technologies into our vehicles, I’m looking forward to attending a live event in 2021 to talk directly with suppliers,” said Huang.

The technical program will be co-chaired by returning 2018, 2019 and 2020 co-chair Dr. David Jack, professor, Mechanical Engineering at Baylor University and returning 2020 co-chair Dr. Alex Kravchenko, assistant professor, Composites Modeling and Manufacturing Group, Department of Mechanical and Aerospace Engineering at Old Dominion University. “The ACCE gives industry leaders, faculty and students the opportunity to present their automotive composites research and advance the industry while getting recognized for their contributions worldwide,” noted Jack. “It is an honor to continue to support the ACCE as technical program co-chair. I greatly value that ACCE supports students with scholarships and career opportunities as we develop the next generation workforce,” added Kravchenko.



DR. XIAOSONG HUANG



DR. KHALED SHAHWAN



DR. DAVID JACK



DR. LEONARDO SIMON



DR. OLEKSANDR (ALEX) G. KRAVCHENKO

THE 2021 ACCE TECHNICAL PROGRAM will include 80 – 100 technical presentations on current and future industry advances. The topics are organized into the following categories: Thermoplastic Composites; Thermoset Composites; Modeling; Additive Manufacturing & 3D Printing; Enabling Technologies; Sustainable Composites; Bonding, Joining & Finishing; Carbon Composites; and Business Trends/Technology Solutions. Paper abstracts are requested as soon as possible and are due by **April 16th, 2021**. Final papers or non-commercial presentations are due **June 18th, 2021**. Authors who submit full papers (not presentations) in the proper format will be considered for the conference's Best Paper Awards, which are presented during the event's opening ceremony. A template for papers can be downloaded from the SPE ACCE website online via <http://speautomotive.com/acce-forms>. Abstracts can be submitted via email to ACCEpapers@speautomotive.com

A VARIETY OF SPONSORSHIP AND EXHIBIT OPTIONS offer companies the opportunity to support the event and promote their products and services to a very targeted and interested audience. Student Poster Competition and Scholarship sponsorships are also available. All sponsorships include passes to the event including access to all keynotes, panel discussions, technical sessions and daily networking opportunities. Sponsorship also includes corporate exposure on SPE ACCE websites, advertising, publicity, social media, signage throughout the event venue and more. Sponsors to date for ACCE 2021 include **Hexion, Ineos Composites, Mitsubishi Chemical, AOC Aliancys, BASF, Engel, Michelman, SAMPE, Composites One, Dieffenbacher, Fraunhofer/Western University, Lotte Advanced Materials and Moldex 3D**. Companies interested in supporting the event with sponsorship and showcasing their products and services should contact Teri Chouinard at teri@intuitgroup.com and go to <https://speautomotive.com/acce-conference/> for more information.

The mission of SPE is to promote scientific and engineering knowledge relating to plastics worldwide and to educate industry, academia, and the public about these advances. SPE's Automotive Division is active in educating, promoting, recognizing, and communicating technical accomplishments in all phases of plastics and plastic-based composite developments in the global transportation industry. The SPE Composites Division is dedicated to the growth of composites in multiple industries. Topic areas for both divisions include applications, materials, processing, equipment, tooling, design, and development.

For more information see <https://speautomotive.com> and <https://composites.4spe.org>. For more information on the Society of Plastics Engineers, see www.4spe.org.

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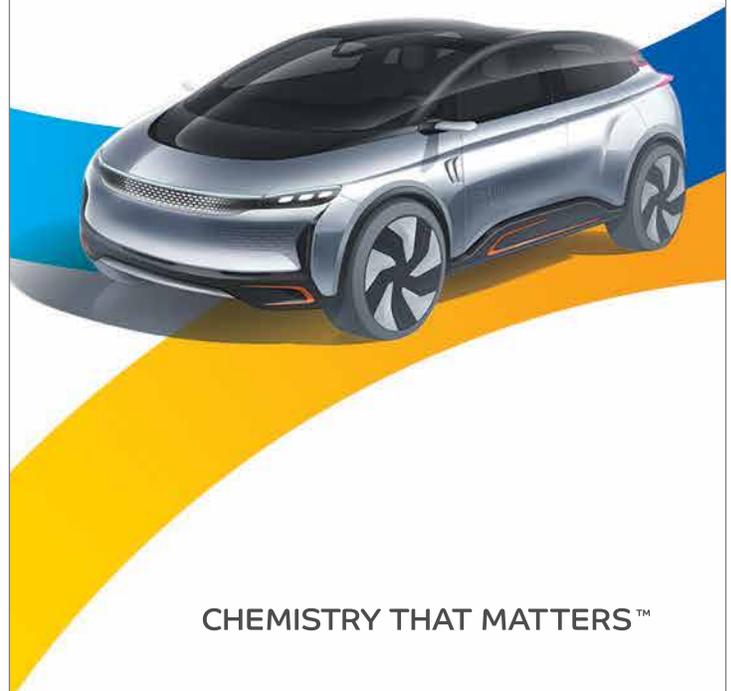
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AUTOMOTIVE COMPOSITES CONFERENCE & EXHIBITION

Novi, MI • September 8-10, 2021

Presented by SPE Automotive and Composites Divisions

WORLD'S LEADING AUTOMOTIVE
COMPOSITES FORUM

DRIVING VALUE



CALL FOR PAPERS SPONSORS & EXHIBITORS FOR ACCE 2021

COMPOSITES: DRIVING VALUE BY REDUCING WEIGHT AND COSTS & INCREASING PERFORMANCE

PRESENT YOUR COMPOSITES TECHNOLOGY at the SPE ACCE 21st annual event. The 2021 ACCE technical program will include 80 – 100 papers/presentations on industry advances organized into the following categories: Thermoplastic Composites; Thermoset Composites; Modeling; Additive Manufacturing & 3D Printing; Enabling Technologies; Sustainable Composites; Bonding, Joining & Finishing; Carbon Composites; and Business Trends/Technology Solutions. Paper abstracts are requested as soon as possible (early submissions will be given priority) and are due by **April 16th, 2021**. Final papers or non-commercial presentations are due **June 18th, 2021**. Authors who submit full papers (not presentations) in the proper format will be considered for the conference's Best Paper Awards, which are presented during the event's opening ceremony. A template for papers can be downloaded from the SPE ACCE website online via <http://speautomotive.com/acce-forms>. Abstracts can be submitted via email to ACCEpapers@speautomotive.com.

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SPONSORSHIP AND EXHIBIT OPTIONS offer companies the opportunity to support the event and promote their products and services to a very targeted and interested audience. Student Poster Competition and Scholarship sponsorships are also available. All sponsorships include passes to the event including access to all keynotes, panel discussions, technical sessions and daily networking opportunities. Sponsorship also includes corporate exposure on SPE ACCE websites, advertising, publicity, social media, signage throughout the event venue and more. Companies interested in supporting the event with sponsorship should contact Teri Chouinard at teri@intuitgroup.com and go to www.speautomotive.com/acce-conference for more information.

2021 SPONSORS





MEMBERSHIP REPORT

SAMAR TELI
SPE AUTOMOTIVE DIVISION MEMBERSHIP CHAIR



First, I would like to thank every member for ongoing support for the SPE. The pandemic has caused significant changes to our lives and has forced us to refocus on our priorities. But it has certainly not affected our commitment to the communities.

Membership in the Automotive division has remained strong. As of December 2020, Automotive division has 856 registered members. During 2020, we added about 190 new members. Our division has more than 550 professional members, about 100 young professional members and more than 150 student members. It is remarkable that more new members joined our division in 2020 than in 2019, despite the challenges we faced throughout the year. I want to take this opportunity to welcome them to our family.

Membership is critical to our success and directly supports our ability to provide the educational outreach and support for young professionals that will help ensure the next generation of leaders in our industry are prepared to inspire the automotive innovations only plastics and composites can provide. The Automotive Division is truly global with members representing many countries. But we want to continue our outreach to every corner of the globe.

I encourage all members who are interfacing with international colleagues please take a moment to share the value you have derived from membership and encourage them to visit <http://speautomotive.com/> and look into some of the benefits of membership in the SPE Automotive Division. I wish you all happy and safe 2021!

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WEBSITE REPORT

TERI CHOUNARD
SPE IAG AND ACCE MARCOM & SPONSORSHIP CHAIR



Check out the new SPE Automotive Div. website <https://speautomotive.com/>

We have a new website! It has a modern design that is easy to use and navigate to find information on all our events, newsletters and more. The home page includes a cool video in the background that instantly engages visitors. We are looking into adding video from the ACCE, IAG, Golf Outing and more as our events resume. Everything is accessible from the Home Page including our Sponsors, Events, Mission, Board of Directors, and Latest News. All the events are streamlined onto one page with links to more info on each event following a custom designed template making info easy to find. Updates are easier to make as well so the site will always be current with updated and timely information.

The new site is also Super Mobile Friendly. Every single page has a super optimized look and feel on smartphones, tablets and screens in any size.

Our website reaches a very targeted audience interested in our Newsletter, Innovation Awards Gala, Automotive Composites Conference & Expo, Golf Outing, and more. You can reach automotive OEMs, Tier Suppliers and other plastics professionals by sponsoring our events and website. Please contact me for more information – A limited number of opportunities to sponsor the website are still available. Contact teri@intuitgroup.com or 248.701.8003.

Special Thanks to Marc Bahm –The new site would not be possible without the continued guidance and technical support from our Webmaster of many years – Marc Bahm. Marc provided great direction and expertise to ensure a smooth transition from our previous site to the new one and extra support to make sure the new site remains safe and secure. Marc will continue to support the website with technical and administrative direction and management.

Special Thanks to our Chair – Alper Kiziltas for his foresight and great leadership in directing the development of the new website and to our **Treasurer – Bonnie Bennyhoff** for overseeing the entire process. Extra kudos to Bonnie for organizing the ACCE papers from 2017,2018 and 2019 into a format so they could be added for easy viewing via the ACCE page.

Special Thanks to our new Website Designer and Producer – Robert Norcross of Web Centre! We are very grateful for the awesome expertise and service provided by Robert and his company – Web Centre. Robert went above and beyond for us and I am proud to recommend him and his company: <https://webcentremi.com/>

A Very Special Thanks to our Website Sponsors – Ascend Performance Materials, BASF, Celanese & Sabic.



TREASURER’S REPORT

BONNIE BENNYHOFF,
SPE AUTOMOTIVE DIVISION TREASURER

AS OF FEBRUARY 16, 2021, THE DIVISION’S ACCOUNT BALANCES WERE:

Checking:	\$349,288.49
Savings:	\$ 27,494.27
Total:	\$376,782.76





AUTOMOTIVE GOLF OUTING

Fieldstone Golf Club • Auburn Hills, MI
Presented by SPE Automotive Division

SEPTEMBER 7, 2021

26TH ANNUAL SPE GOLF OUTING

PROCEEDS BENEFIT SPE STUDENT CHAPTERS

2021 SPONSORSHIP OPPORTUNITIES

TYPE OF SPONSORSHIP	COST	BENEFITS INCLUDE
CONTEST HOLE	\$1000. USD	1 foursome, signage, flag & more
HOLE	\$750. USD	1 foursome & signage
BREAKFAST	\$1500. USD	1 foursome & signage with company Logo
LUNCH	\$2000. USD	2 foursomes, signage & 100 fliers printed & distributed at the event promoting sponsoring company or its products
DINNER	\$3000. USD	3 foursomes, signage, company message / logo on dinner table centerpieces, 100 fliers printed & distributed at the event promoting sponsoring company or its products

SPONSORSHIP CHAIR:

Teri Chouinard, Intuit Group

+1.248.701.8003

teri@intuitgroup.com

<https://speautomotive.com/spe-golf-outing/>

SEPT 7 2021

COST:

\$500. USD/Foursome

\$125. USD/Player

PROGRAM:

8:30am: Sign-in & Continental Breakfast

10:00am: Shotgun Start

Box Lunch at Turn

3:30pm: Buffet Dinner

4:00pm: Awards & Prizes



FIELDSTONE GOLF CLUB
1984 Taylor Road Auburn Hills, MI 48315

22ND ANNUAL



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Now in its third decade, the Conference is the world's leading engineered polyolefins forum typically featuring 70+ technical presentations, select keynote speakers, networking, receptions, & exhibits that highlight advances in polyolefin materials, processes, and applications technologies as well as a growing range of thermoplastic elastomers (TPEs) and thermoplastic vulcanizates (TPVs). This year's event is planned to be an all new hybrid format featuring live in person and virtual elements, promising an even greater global scope of participation. The conference will be held **October 3-6, 2021** at the Detroit Marriott Troy (Troy MI USA) as well as online virtually for global participants.

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The *SPE TPO Global Automotive Engineered Polyolefins Conference* typically draws over 900 attendees from 20 countries on 4 continents who are vitally interested in learning about the latest in rigid and elastomeric TPO as well as TPE and TPV technologies. Fully a third of conference attendees work for a transportation OEM, and nearly 20% work for a tier integrator. Few conferences of any size can provide this type of networking opportunity or put you before such an engaged, global audience interested in hearing the latest olefin advances. Interested in presenting your latest research? Abstracts are due **April 9, 2021** and Papers/Presentations on **July 9, 2021**. Email abstracts/papers to TPOpapers@auto-tpo.com.

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TPO 2021 CONFERENCE TECHNICAL PROGRAM SESSIONS & CHAIRS:

Scope of each session and suggested topic areas are provided on conference website: www.auto-tpo.com

MATERIALS DEVELOPMENT

- Mark Jablonka, The Dow Chemical Company
- Peter Glenister, LyondellBasell
- Catherine Wilson, Ford Motor Company

SURFACE ENHANCEMENTS

- Dr. Rose Ryntz, Ryntz & Associates
- Jim Keller, Mankiewicz Coatings
- Jeff Crist, Ford Motor Company

INTERIOR APPLICATIONS & LAMINATING ADHESIVES

- Dr. Pravin Sitaram, Haartz Corporation
- Austin Wagenhals, Ford Motor Company
- Hoa Pham, Freudenberg Performance Materials

PROCESS DEVELOPMENTS & SIMULATIONS

- Mike Cuneo, Washington Penn Plastic Co., Inc.
- Dr. Suresh Shah, SPE Fellow

LIGHTWEIGHTING OF POLYOLEFIN PARTS

- Mike Shoemaker, Borealis Compounds
- Dr. Nadeem Bokhari, Sumitomo Chemical
- Normand Miron, Washington Penn Plastic Co., Inc.

APPLICATIONS FOR BIO BASED MATERIALS

- Dr. Alper Kiziltas, Ford Motor Company
- Akshay Trivedi, Lear Corporation
- Drew Geda, Hyundai Motor Group

ENABLERS FOR PLASTICS RECOVERY & REUSE

- Mike Balow, Auxin Consulting
- Dr. Suresh Shah, SPE Fellow
- Susan Kozora, IAC Group

INNOVATIONS IN PLASTICS FOR FUTURE MOBILITY

- David Helmer, General Motors Company
- Andrew Sanders, Borealis Compounds
- Frank Schumann, Trinseo, LLC

SUNDAY WORKSHOP

KEY CONFERENCE CONTACTS

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David Helmer, General Motors
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SPONSORSHIP/EXHIBIT CO-CHAIRS

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David Okonski, General Motors
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For information and registration visit our website at auto-tpo.com or call Karen at +1.248.244.8993, Ext 3, karen@auto-tpo.com

SPONSOR NEWS

A NEW FEATURE SECTION FOR NEWS FROM OUR SPONSORS



INCOE'S SOFTGATE® VELOCITY VG PIN CONTROL TECHNOLOGY

Direct valve gating a part while over-molding film or fabric, in mold decorating (IMD) has many challenges. The “blast” of the plastic in the gate area can often damage the film or wrinkle the fabric. Many

years ago, INCOE recognized that challenge and introduced their **SoftGate® Velocity VG pin control technology** to the market that then allowed these applications to be direct gated. SoftGate® allowed the melt to stream over the decorative film without damaging it. The impact caused by melt flowing abruptly into the cavity after the valve gate nozzle has been opened **conventionally** can be seen in the image detail: After SoftGate® was switched off, the decorative film broke in the gate area. Today, this tried and proven Valve Gating technology may be just the solution that you need. There are additional application and processing benefits of this technology. Questions? INCOE is here to provide solutions.



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A global company that is 100% family owned and operated with a commitment to supporting the plastics industry, innovating new products and providing “best in class” service to our customers is our priority. Supported by an experienced team of professionals in over 45 countries, our commitment is to quality, partnership and most importantly, bringing the application specific expertise that benefits you; our customer.

For more information, you can find us at www.incoe.com.



SPONSOR NEWS

A NEW FEATURE SECTION FOR NEWS FROM OUR SPONSORS



BASF'S NEW VIRTUAL CAR DRIVES MOBILITY INDUSTRY FORWARD

BASF Automotive Solutions is excited to announce the launch of our virtual car. From engineering plastics and coatings to cathode materials, fuels and lubricants and more, this new interactive tool presents BASF's broad portfolio of automotive solutions to help customers continue to innovate and drive the mobility industry forward. With the virtual car, automotive OEMs, engineers, designers and developers can explore by specific materials or material properties, across vehicle segments, by different powertrains or by industry topic to determine which BASF solutions will best address their needs.

Alex Horisberger, senior specialist design consultant at BASF, helped lead the development of the virtual car. With a background in product design and experience working with engineers, Alex coordinated across BASF's global teams to ensure the virtual car is a functional, technical and aesthetically pleasing tool. In the interview below, Alex shares more on the virtual car and how it can inspire those who are helping transform the industry.



TELL US MORE ABOUT THE VIRTUAL CAR AND WHAT IT OFFERS AUTOMAKERS.

The virtual car is designed to show automakers how BASF materials can help solve the challenges facing the industry. Beyond its technical function, the elegant design is intended to motivate and inspire designers and engineers to explore new ways to leverage our material know-how against their toughest challenges.

We know that the current pace of change in automotive is intense. That's why you won't see any fleeting or trendy elements found in cars today. It was important to create a balance to show which BASF solutions can help answer the question, "what now?", while also providing a glimpse into how they can help answer the question, "what's next?".

Read the full article here <https://basf.smh.re/6zn> from one of our designers and explore the BASF virtual car to get to know BASF's chemistry-driven automotive solutions.

If you would like to talk to someone about this, please reach out at BASFAutomotiveSolutions@basf.com.





DR. NORM KAKARALA
& TOM PICKETT

2021 ANTEC TO TAKE PLACE IN MAY

The SPE Annual Technical Conference (ANTEC) have changed dates from March to May. The conference will be a virtual event. “The unfortunate cancellation of NPE gives SPE the opportunity to move its annual technical conference back to its traditional May timeframe,” says SPE CEO Patrick Farrey. “SPE had previously agreed to move ANTEC to March to avoid the conflict of having two major industry events in the same month but May has always been the preferred timeframe for our members, attendees, exhibitors and sponsors.”

IMPORTANT DATES

- ANTEC Industry Insights – May 5-7, 2021
- ANTEC Classic – May 10-21, 2021
- ANTEC International – starts May 24, 2021

At the time of this report, SPE Headquarters have not determined the date for the Automotive Session.

The Co-Chairs of the 2021 ANTEC Automotive Division Session are **Norm Kakarala** and **Tom Pickett**. The Automotive Session accepted nine technical presentation from OEMS and suppliers on important topics in the automotive industry. Judges for the papers were **Tom Pickett, Norm Kakarala, Dave Helmer, Suresh Shah, Alper Kiziltas** and **Sassan Tarahomi**.

For more information about ANTEC visit the website at www.4spe.org

FULL LIST OF TOPICS INCLUDE

- | | | | |
|---|--|---------------------------------------|-----------------------------------|
| • Additive Manufacturing/
3D Printing | • Color & Appearance | • Injection Molding | • Product Design
& Development |
| • Advanced Energy | • Composites | • Joining of Plastics
& Composites | • Reaction Injection
Molders |
| • Alloys & Blends | • Decorating & Assembly | • Medical Plastics | • Rotational Molding |
| • Applied Rheology | • Electrical & Electronic | • Mold Technology | • Sustainability |
| • Automotive | • Engineering Properties
& Structures | • Plastic Analysis | • Thermoforming |
| • Bioplastics & Renewable
Technologies | • Extrusions | • Plastic Pipe & Fittings | • Thermoplastics Elastomers |
| • Blow Molding | • Failure Analysis | • Plastics Recycling | • Thermoset |
| • Building & Infrastructure | • Flexible Packaging | • Polymer Modifier
& Additives | • Vinyl Plastics |
| | • Foams | | |

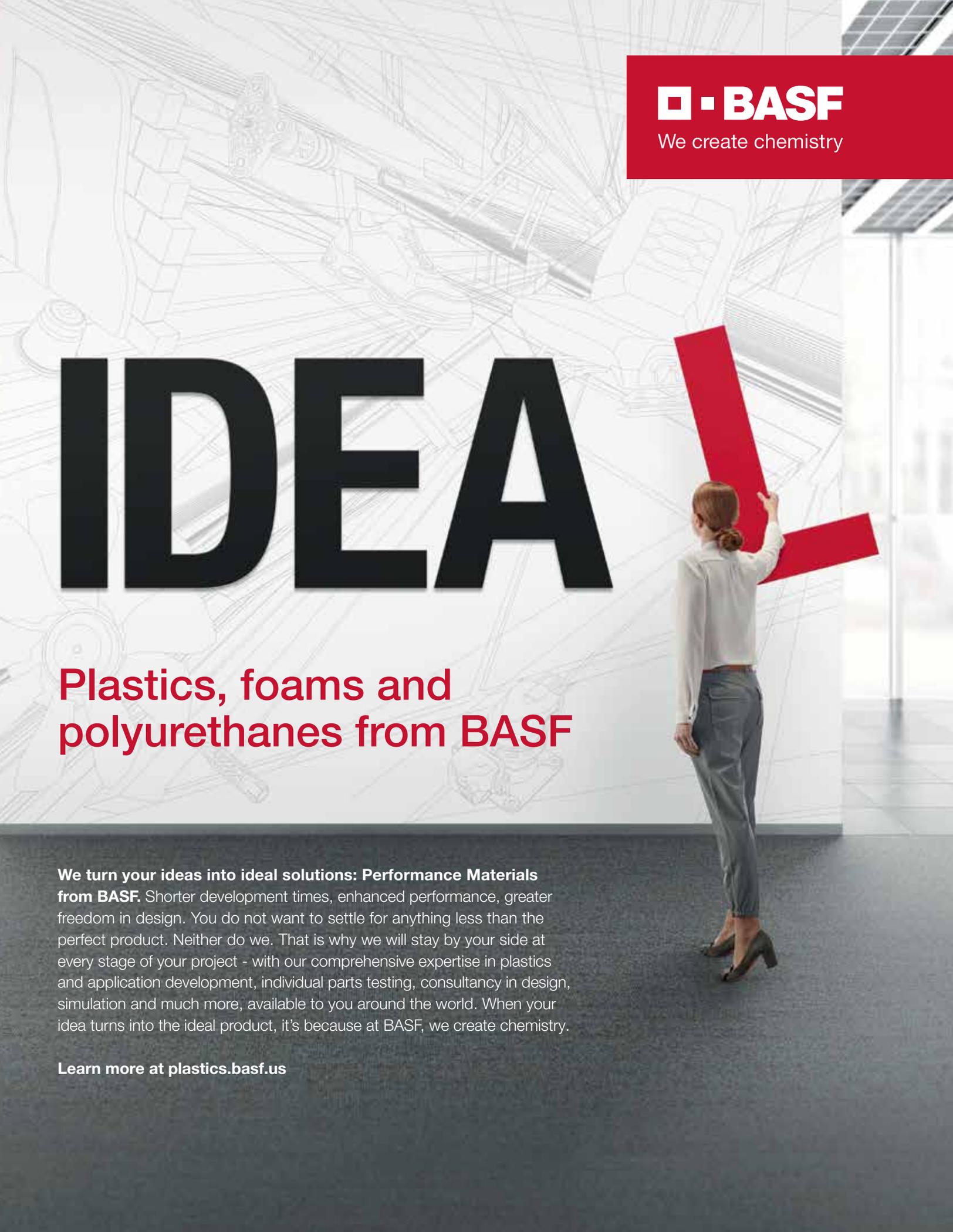
CONTACTS:

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



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AUTOMOTIVE

COUNCILOR'S REPORT

SPE COUNCIL VIRTUAL MEETING
MINUTES, JANUARY 28, 2021
BY DR. SURESH SHAH

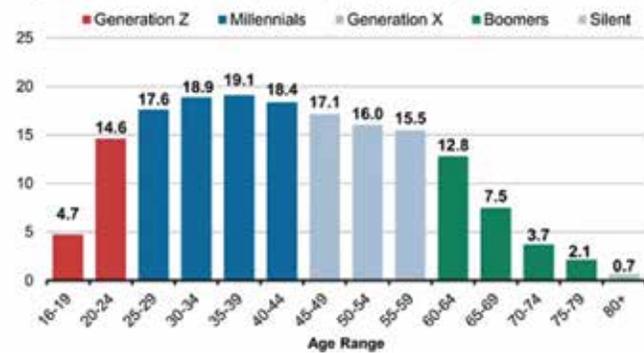


JAIME GOMEZ - PRESIDENT

Three years redefined SPE to increase value to our members. Work force is changing as shown below. The way networking and communication has changed, learning has also changed to focused on computer-based learning. Society today is much more focused on the environment.

The Workforce in 2025

Projected size of U.S. labor force (in millions) by age, for the year 2025



How can SPE change to meet the new demands from our members. COVID-19 forced us to transition from Crisis mode to Opportunity mode. SPE reinvented ourselves in a matter of weeks. Covid was a catalyst that forced us to reinvent SPE. Look at ANTEC as an example. We went from face to face conference to a very successful virtual conference.

WORK GOES ON!

ACT - ACTION CHANGES THINGS....

- Virtual ANTEC
- EB Advancing Strategic Initiatives
- Business Development & Technology Committee
- New Style of Leadership Meetings (Council, CCOW)
- 'Plastics In...' Series
- Plastics Forum (Spanish)
- Presentations in INDIA (RACE) & Australia
- RIG Communities
- Videos (Foundation)

JASON LYONS - SPE PRESIDENT ELECTVISION FOR 2021

Cannot be everything to everybody.

Recipe for success: Engage and motivate members, provide quality programs and content and most critical is provide Value. It should be bottom-up pyramid structure.

We should start by supporting plastics professionals so that they can learn from each other and inspire positive change for society and the planet.

- Enhanced reputation
- Increased engagement and networking
- Credible knowledge sharing

Going forward:

Two pillars

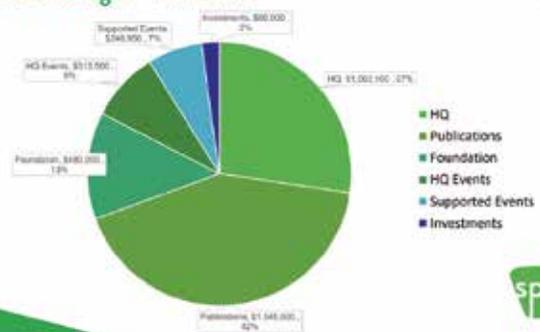
- Information (tech papers, patents, seminars, training, journals)
- Connections (people centric, friendships, business relationships, communities, Prof Dev)

Budget:

2021 Budget is forecasted to be similar to 2020.

- HQ was diligent in keeping expenses low
 - Over last three years expenses have continued to drop
 - > Head count and wages stayed same
 - > Significant technology and operational savings
- Big revenue coming from publications @ \$890M

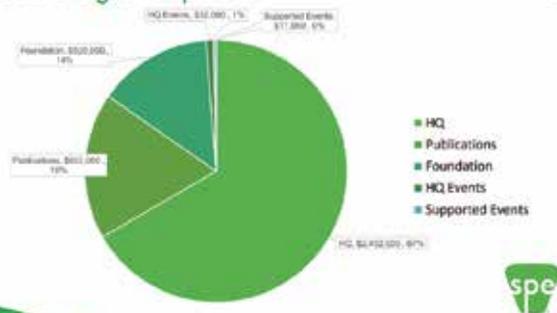
SPE 2021 Budget - Revenue



COUNCILOR'S REPORT

CONTINUED

SPE 2021 Budget - Expenses



CEO UPDATES – PAT FARREY

- ANTEC moved back to May 5
 - Historically was May but moves when NPE is on
 - ANTEC only major plastics event this year
 - May 24 onward
 - > ANTEC international – events specific to global locations
 - Bringing back student posters at ANTEC
- Chain has been replaced by Communities
 - >500 communities set up in the “Chain” – 480 were dormant
 - New communities have been set up – Chapters are encouraged to use the new set up – No charge
 - If you want to see the community/s you like, you will need to subscribe and set up notifications
- Plastics Engineering – published by Wiley who are great at this sort of thing
 - Pat stated that we will bring this in house
 - Lots of staff with trade publication experience
 - Cited examples where PEM would feature a topic but the chapter that covers that area had no knowledge of it
- PlastiVideos
 - Bring PlastiVan to remote teaching
 - > Go take a look
 - Social media starting early Feb
 - > Detroit and Automotive sections large supporter

MEMBERSHIP TRENDS

	Paid Members	Total Customers
July 2018	7,663	24,272
Jan 2019	8,706	25,807
Jan 2020	9,222	37,616
Jan 2021	8,058	26,377

SECRETARY'S REPORT

SPE AUTOMOTIVE DIV. VIRTUAL BOARD MEETING MINUTES DECEMBER 7, 2020, BY STEVE VANLOOZEN



- Changes to the Board including Committee Chairs and the Executive Committee were reviewed. Automotive Division still has vacancy in the vice-chair position. Alper to send e-mail requesting nominees to the board.
- 2021 SPE ACCE discussions focused on live vs. virtual event. It is likely the committee will move to a hybrid event for 2021. The virtual modules do allow speakers and attendees unable to travel to participate and keeping the virtual aspects that worked well in 2021 would allow the ACCE to reach the broadest audience possible. The committee likely will not include the exhibition hall at the 2021 ACCE for both safety and cost reasons.
- Gary Kogowski shared that the 2021 AutoEPCON has been officially cancelled and that the committee has decided not to proceed with a virtual event.
- The automotive newsletter moving to 100% digital was discussed and the consensus of the board was that this decision was entirely appropriate given this is the direction of most periodic publications.
- Bonnie Bennyhoff delivered a concise financial report for the division which projected a greater than \$145K loss for the division in our 20-21 fiscal year. Costs are being controlled or removed from the budget entirely where possible. The division remains viable with over \$375K in assets.
- A one-time only category to provide special recognition for Covid response will be added to the 2021 Innovations Awards Gala.
- Dr. Umesh Gandhi has been selected as a "Fellow of the Society". This is a very prestigious technical award and SPE has very tough criteria for selection. He is the 7th person in the history of the Automotive Division to receive this award. The award will be presented at the 2021 ANTEC.
- Next meeting: February 22, 2021 5:30-7:30 PM.



IMPROVED AUTOMOTIVE INDUSTRY OUTLOOK, ELECTRIFICATION AND INNOVATION

Happy New Year! This report covers two recent reports: the OESA Supplier Barometer Index™ that measures the outlook of automotive supplier executives, and the European ACEA 2020 progress report, focusing on automotive electrification and charging stations. Also, this report will highlight two recent important events (virtual only): Formnext Connect, the largest exhibition

of the additive manufacturing industry and the Vehicle Technology at the 2021 Consumer Electronic Show.

OESA Supplier Barometer Index™ measures the sentiments of North American automotive supplier executives. The latest measure from Q4 2020 indicated a continued strength in light vehicle production volumes that boosted the industry outlook compared to three months earlier. This report focused on capital markets and innovation with nearly 85% responses confirmed that the company's capital structure supports the innovation objectives. Additionally, the results indicate: i) the COVID-19 pandemic remains as the greatest threat to the industry, however, at a lower threat rating compared to the second quarter of 2020; ii) light vehicle production volumes are projected to surpass the volumes needed to break-even in 2020; iii) automotive suppliers will require capital investment for product innovations in 2021 to meet end user's demands; and iv) a majority of suppliers are confident with their pace of innovation that is either on pace or ahead of the industry.

The European Automobile Manufacturers' Association (ACEA) published the ACEA 2020 progress report. The study found

that despite the strong growth of electric vehicle adoption and available charging infrastructure in Europe, the number of charging stations grew by just 58% to under 200,000 compared to the 110% sales growth of plug-in vehicles over the past three years. Also, four countries account for more than 75% of all EV charging points, Netherlands, Germany, France and the UK. DC fast chargers account for only 1 in 7 charging points in Europe. The report also provides information regarding market uptake of alternatively-powered vehicles, carbon dioxide emissions of new passenger vehicles, affordability of electrically-chargeable vehicles, and infrastructure availability. The report includes an estimate by the European Commission, that at least 2.8 million charging stations will be needed by 2030, which translates to a 14-fold increase in the next 10 years.

Formnext Connect, the largest exhibition for the Additive Manufacturing industry, took place on November 10 - 12, 2020, purely virtual. This event attracted 203 exhibitors and more than 8,500 participants from more than 100 countries. 221 presentations discussed the current and future trends, developments and applications available also on-demand until December 31, 2020. Wednesday November 11, 2020 included a discussion of how 3D printing can be used in the automotive industry with representatives from tier suppliers and OEMs.

The highlights of Formnext Connect 2020 include hardware and software improvements of multiple equipment manufacturers that offer higher efficiency, productivity and quality. New equipment introduced at the event featured large format machines and high-volume for serial production that can produce at speeds 20 times faster than standard single-laser systems and five times faster than a quad-laser unit. Also, automated post-processing solutions for powder removal, digitalization of the additive workflow, and support material removal through a combination of software, hardware and chemistry for high-speed, high-volume production. Additionally, Formnext awarded for the first time the Startup challenge impact to MolyWorks, a startup company that invented a closed loop metal recycling system turning metal scrap into metal powder, and turning that into parts. This award recognizes startups that take important steps towards enabling the circular economy in the additive manufacturing industry.

The Vehicle Technology at the 2021 Consumer Electronics Show (CES) presented major announcements about electric vehicles, autonomous vehicles technology and batteries, infotainment and safety systems. GM introduced the second-generation Ultium batteries that are expected to cost less by the reduced use of Cobalt while increasing the energy density compared to today's cells offering a range of up to 450 miles. GM plans to launch 30 electric vehicles globally by 2025. Also, GM presented three prototype Cadillac vehicles: i) Halo, a luxury van with living room style interior fully automated; ii) eVTOL, a for-rotor electric aircraft taxi, single-seater, capable of vertical takeoff and landing; and iii) CelestiqEV, a luxury electric sedan with four-wheel steering and multiple electric features, such as the electrochromic glass roof, a pillar to pillar screen dashboard and personalized rear screens in the back. In addition, GM introduced BrightDrop, a new logistics focused division of all-electric products including a motorized pallet and locking cabinet called the EP1 and a delivery van called the EV600 built on GM's Ultium platform.

Some of the highlights from the show include, Mobileye's new solid state Lidar that is much smaller and lighter than competitive products, it will offer accurate sensing capabilities at up to 200 m and it is expected to be in production by 2025. Mercedes-Benz MBUX Hyperscreen features a 56-inch infotainment display that will launch in the upcoming EQS electric sedan. This hyperscreen eliminates the need to dig through various menus or use voice commands to access certain functions. The system can also learn your habits and preferences and proactively respond thanks to artificial intelligence. Sono Motors presented their electric vehicles with solar charging capabilities that already have more than 12,000 reservations to deliver cars to European roads by 2022.

Overall, electrification in automotive remains the common trend including large investments to support innovations that showcase the convergence of automotive with autonomous vehicle technology, batteries and safety systems. The growth in adoption rate of electric vehicles also requires a growth in available charging infrastructure, as presented by a recent European study that cited an estimate by the European Commission of 2.8 million charging stations needed in Europe by 2030, which represents a 14-fold increase. The developments in additive manufacturing set the trend to deliver solutions to larger formats and high efficiency equipment to support serial production coupled with automated post-processing solutions. Lastly, despite the COVID-19 pandemic, automotive suppliers have a positive outlook based on the continued strength of light vehicle production volumes that support the capital investments required for product innovations that end users demand.



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TECHNICAL REPORT

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WATER ABSORPTION BEHAVIOR OF MECHANICALLY RECYCLED PP AND PA6 COMPOSITES REINFORCED WITH NATURAL FIBERS AND GLASS FIBERS

ABSTRACT

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.

1. INTRODUCTION

The extensive use of thermoplastics and their composites in our society is causing growing concerns due to its adverse effects on our environment [1]. There are several ways to reutilize polymers for sustainable models such as reuse, chemical recycling, and mechanical recycling. Of these, the latter two are the most widely practiced methods of recycling [2]. This study focuses on the mechanical recycling of polymer composites with various mineral and natural fillers. In general, mechanical recycling includes regrinding and reprocessing the polymer composite to produce a new component. The main problem with this type of recycling includes degradation in mechanical properties due to the shortening of fibers, damage on the surface of the fiber, delamination on the wall of natural fiber, fiber-matrix debonding, thermomechanical degradation on coupling agent, and reduction in molecular weight [3]. Poor retention of mechanical properties leads to recycled material generally being downgraded for the next cycle of an application. Although there have been attempts to use additives to upgrade the mechanically recycled polymer composites [4].

In the automotive industry, the use of polymer composites continues to grow due to its contribution to lightweighting, which directly impacts fuel economy. Metal components in automotive vehicles are replaced by plastics or composites resulting in lightweight vehicles. A reduction in 10% weight leads to a 3% to 7% improvement in fuel efficiency [5]. High-density fillers such as glass fibers or minerals (talc, calcium carbonate) are generally used to reinforce the polymer matrix to improve the mechanical properties of the composite without sacrificing the overall cost of the component. However, mechanical recycling reduces the reusability of these composites. The length of the fiber, which directly relates to the improvement in the mechanical properties, is greatly reduced due to the brittle nature of glass fibers. Fiber attrition has also been observed in injection molded components where the fibers must navigate through thin and convoluted sections. Additionally, the reduction in the molecular weight of the polymer matrix due to thermomechanical degradation

could further exacerbate the issue with recycling. In contrast to glass fiber reinforcement, composites reinforced with natural fiber exhibit very little to no changes in mechanical properties after recycling [6]. This is because natural fibers can withstand external mechanical forces and are less likely to break due to their complex internal compositions [6] [7]. Injection molding is a widely utilized manufacturing method for polymer composites in the automotive industry. The presence of a resin-rich layer at the surface of injection molded components protects the hydrophilic natural fillers from moisture intrusion.

In this study, various natural fiber and glass fiber composites are investigated for degradation in mechanical properties due to grinding and reprocessing, and the effect of recycling on water absorption behavior. Tensile tests, flexural tests, and impact tests were conducted to assess the mechanical properties of dry (control) and saturated specimens subjected to various hygrothermal conditions. To further investigate the cause of degradation in tensile and flexural properties, measurements of fiber length distribution are carried out.

2. MATERIALS

Table 1 shows the list of composite materials considered in this study. There are three natural fiber reinforced composites, one hybrid composite, and four composites with mineral fillers (talc and glass fibers).

Table 1 Thermoplastic composites considered in the study

NOTATION	MATRIX	FILLER	FILLER TYPE
WF	PP Copolymer	20% Wood pine fiber	Natural fillers
RH	Recycled polyolefin (PP and PE)	10% Rice hull	
C20	PP	20% Cellulose	
CGF	PP	10% Cellulose 15 Long glass fiber	Hybrid
T40	PP Homopolymer	40% Talc	Mineral fillers
GB	PP	29% Talc 7% Glass bubbles 5% Short glass fiber	
GFC	Chemically coupled PP	30% Short glass fiber	
LGF	PP	30% Long glass fiber	
NGF	Nylon 6	15% Short glass fiber	

3. EXPERIMENTAL WORK

3.1. SAMPLE PREPARATION AND RECYCLING

Figure 1 shows the mechanical recycling process adopted in this study. During the first cycle, virgin pellets are fed into the injection molding machine to fabricate test specimens. A set number of specimens are collected for mechanical and physical characterization. The rest of the specimens are ground and then oven-dried at 105°C for four hours. In the second cycle, the oven-dried pellets are injection molded and the process is repeated up to five cycles. All specimens were prepared via injection molding using the parameters presented in Table 2.

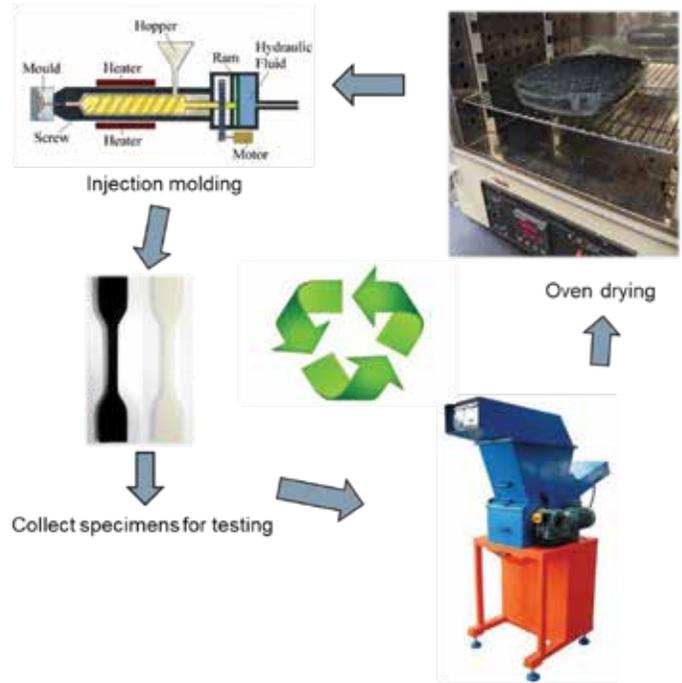


Figure 1 Recycling steps used in this study for thermoplastic composites

Table 2 Processing parameters for injection molding

Barrel temperature (from hopper to nozzle):	
PP composite	182, 188, 191, 193, 193°C
Nylon composite	238, 243, 246, 249, 249°C
Back pressure	689.5 kPa
Hold pressure	1999.5 kPa
Screw speed	70 rpm
Injection time	
Hold time	1 sec
Cooling time	25 sec
Total cycle time	
Mold temperature:	
PP Composites	29.4°C
Nylon composite	60°C

3.2. WATER ABSORPTION TESTS

Before starting the water absorption tests, specimens were conditioned at 23°C and 50% relative humidity for at least seven days before taking the initial dry weight measurement. Water absorption tests were carried out by immersing the specimens in tap water per ASTM D570. While immersing the specimens in water, spacers were kept between the flat surface of the specimens to allow water absorption. Absorption tests were performed on three sets of specimens for each type of composite at 23°C. Each set of specimen consists of seven specimens.

Weight measurements were taken after 1, 2, 3, 7, 14, and every two weeks thereafter until the specimens saturated. The procedure for taking readings for specimens immersed at 23°C is as follows: the specimens were taken

out from the water one at a time, placed vertically to allow water to drain for 30 s, then surface moisture was wiped off, weight measurement was taken and the specimen is placed back in the water. Water absorption percentage was calculated by using the following equation:

$$\%M = \frac{M_{wet} - M_{dry}}{M_{dry}} \times 100$$

Where, $\%M$ is the percentage of water absorbed, M_{wet} is the mass of the specimen (g) subjected to water absorption for a certain time, M_{dry} is the initial dry mass (g).

3.3. FREEZE-THAW EXPOSURE

Since these materials are to be used for exterior application, composite materials were subjected to freeze-thaw exposure. Following ASTM D7032, one set of specimens saturated at 23°C were subjected to -29°C for 24 h, followed by thawing at 23°C for 24 h. This completes one freeze-thaw cycle. Specimens were subjected to five such cycles. These specimens were subsequently conditioned at 23°C for at least seven days while immersed in water for the assessment of mechanical properties through tensile and flexural tests.

3.4. RE-DRYING

To determine mass loss due to water absorption, specimens saturated at 23°C were re-dried in an oven at 50°C. Specimens were periodically weighed until the average change in weight was less than 5 mg.

3.5. MECHANICAL TESTS

Instron Dual Column Universal Testing System (Model 3366) was used for both tensile and flexural tests. Tensile tests were conducted on Type V specimens (ASTM D638) at a loading rate of 5 mm/min until failure or up to a maximum engineering strain of 10%, whichever occurred first.

A 5 kN load cell was employed to monitor the force in the specimen and an extensometer was used to directly monitor the strain in the gage length. A 500 N load cell was used for quasi-static three-point flexural tests. Specimens were loaded at a strain rate of 5% per min until failure or up to a maximum strain of 5%, whichever occurred first. Calculation of strain was based on the deflection in the middle of the specimen monitored from the crosshead displacement of the machine per ASTM D790.

All the test specimens were conditioned at 23°C for at least seven days. For instance, the specimens subjected to freeze-thaw cycling were conditioned by immersing them in water at 23°C for at least seven days before testing. While performing tests on wet specimens, the specimens were taken out of the water one at a time and weight measurements were taken following the procedure outlined earlier and placed in the Instron and tested.

Notched Izod impact testing was also conducted on the control specimen using a pendulum arm impact tester (Model 43-02-03) per ASTM D256. Specimen preparation included creating a standard type V notch using a notch cutter (Model TMI 22-05) on rectangular bars. At least ten specimens for each composition were tested where each specimen was clamped with a constant force.

3.6. FIBER LENGTH DISTRIBUTION MEASUREMENTS

Fiber length distribution of glass fiber composites is carried out by burning the specimen in an oven at 600°C for 2 hours. The retracted fibers are then gently mixed in an acetone solution by pouring between two beakers for at least 5 minutes. Then the resulting solution is poured onto a glass plate and observed under a microscope once the acetone has evaporated.

For natural fiber composites, the fibers are extracted by dissolving the composites in Decalin. Small pieces of composites with Decalin are placed in a round-bottom flask, which is immersed in an oil bath heated at 150°C. Mixing was carried out using a magnetic stirrer and a complete dissolution of the composites took place in 45 mins. The viscous mixture was then allowed to cool before diluting with acetone solution to be observed under a microscope.

4. EXPERIMENTAL RESULTS

4.1. MECHANICAL PROPERTIES

4.1.1. TENSILE PROPERTIES

Tensile strength, tensile modulus, and strain to failure for control samples are presented in Figure 2. As expected, natural fiber-reinforced composites have the lowest tensile properties. Both wood fiber and rice hull reinforced composites did not fail within 5% strain, while all other composites failed below a tensile strain of 5%. The GB composite with talc, glass bubbles, and glass fiber was found to be the most brittle one with a strain to failure of only 1.67%. Long glass fiber PP composite has the best overall tensile properties.

After recycling, there is a significant decrement in the tensile strength of glass fiber reinforced composites (Figure 3). Whereas, a marginal effect was found on natural fiber-reinforced composites or talc composite due to recycling. The effect of recycling on modulus is not as pronounced as strength. In general, strain to failure increases slightly with recycling. For nylon glass fiber composite, strain to failure after the fifth cycle is very high (~8%) compared to 2 – 2.5% for earlier cycles (Figure 3). This could be attributed to the moisture present in the nylon matrix in the later cycles, which act as a plasticizer. Yield stress decreases with water absorption due to an increase in chain mobility in the presence of water [8]. It is worth noting that no appreciable changes in appearance were observed after recycling. The least retention of properties for glass fiber reinforced composites was observed after five batches of recycling. Natural fiber-reinforced composites and talc reinforced composites were least affected by recycling with retention of more than 90% tensile strength property. Whereas, glass fiber reinforced composites have about 60-70% modulus property retention after five batches of recycling.

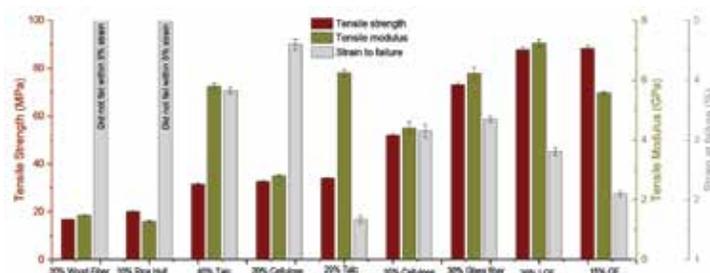


Figure 2 Tensile properties of control samples for thermoplastic composites

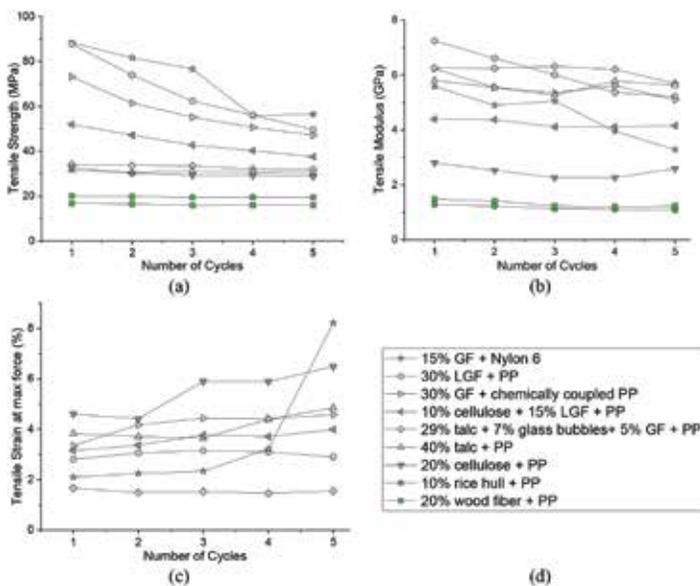


Figure 3 Thermomechanical degradation of tensile properties after mechanical recycling (a) tensile strength, (b) tensile modulus, (c) tensile strain at maximum force, (d) legend

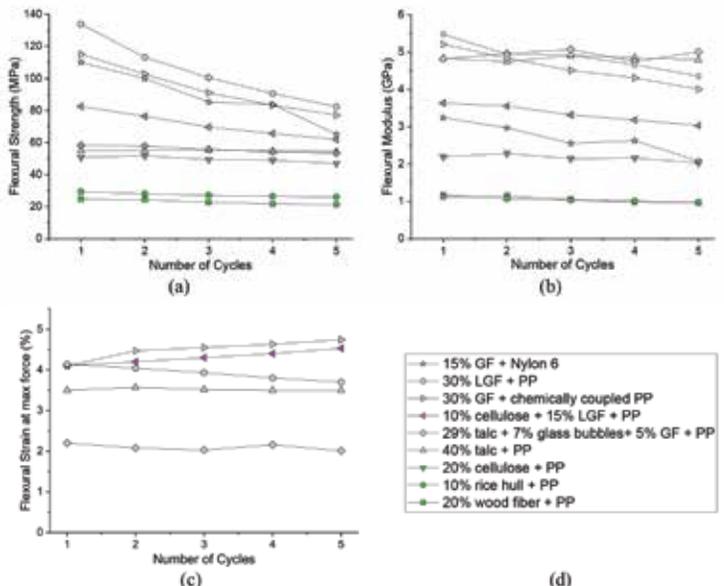


Figure 5 Thermomechanical degradation of flexural properties after mechanical recycling (a) flexural strength, (b) flexural modulus, (c) flexural strain at maximum force, (d) legend

4.1.2. FLEXURAL PROPERTIES

Results on the flexural properties of control samples are similar to the tensile properties. Long glass fiber composites have the overall best flexural properties (Figure 4). Whereas, natural fiber reinforced PP composites have the lowest flexural properties. Trends of decrement in flexural properties after recycling are also similar to tensile properties. A significant decrement was observed in the flexural strength of glass fiber reinforced composites, especially the ones with long glass fibers. A decrement in modulus is not as significant as flexural strength. Recycling has a marginal effect on natural fiber-reinforced composites or talc composite.

Similar to tensile properties, the least retention of properties was observed for glass fiber reinforced composites after five batches of recycling with retention of only 60-70% strength properties after recycling (Figure 5). More than 90% of tensile strength property retention was observed for natural fiber-reinforced composites. Talc reinforced composites seem to be unaffected by recycling.

4.1.3. IMPACT PROPERTIES

As expected, wood fiber and rice hull reinforced composites have the highest impact resistance and are least affected by recycling (Figure 6). Impact resistance of glass fiber reinforced composites is severely affected by recycling. For long glass fiber reinforced polypropylene composite, after five recycles, impact resistance is only 39% of the first cycle.

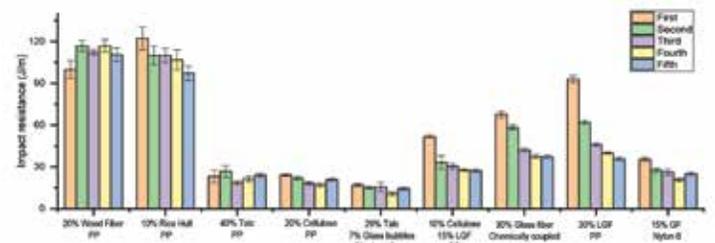


Figure 6 Degradation in impact properties after mechanical recycling of the composites

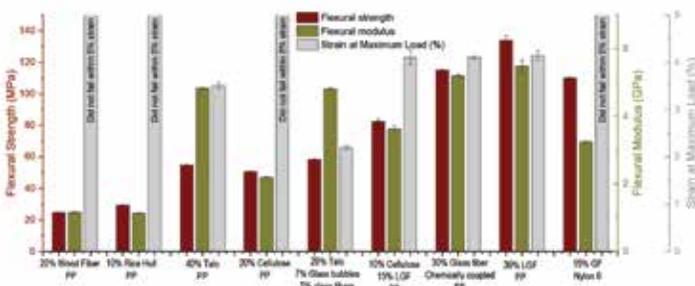


Figure 4 Flexural properties of control samples for thermoplastic composites

4.2. WATER ABSORPTION TESTS

Only glass fiber reinforced nylon composites showed water absorption at 23°C with the maximum intake being 6.5% to 7.7% (by wt.) at saturation. The percentage of water absorption at saturation decreased slightly with recycling. No dimensional instability (warping) or changes in physical appearance was observed for nylon composites after immersion in water. However, thickness swelling of about 6.5% was observed. All other composites did not absorb water even after 45 days of immersion.

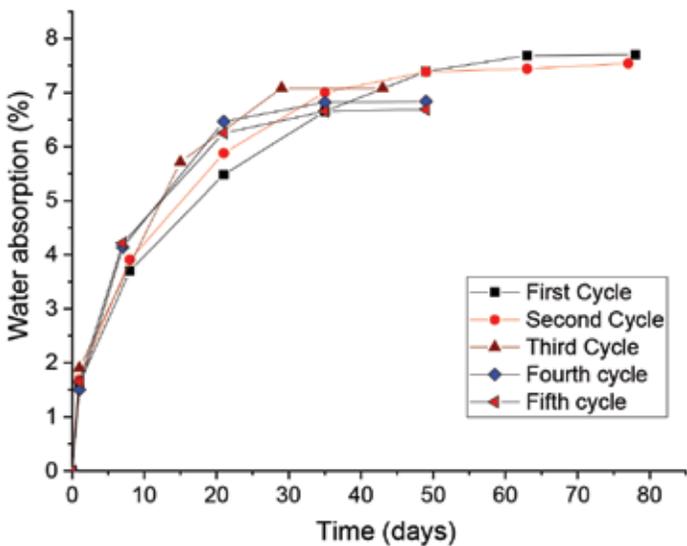


Figure 7 Water uptake (by wt.) for glass fiber reinforced nylon composites

4.3. HYGROTHERMAL EFFECTS ON MECHANICAL PROPERTIES

Strength and modulus properties decreased significantly after subjecting the saturated nylon composites to hygrothermal conditions. Subjecting saturated specimens to five cycles of freeze-thaw did not have any significant effect on the mechanical properties of the nylon composites. Water absorption had irreversible effects on the mechanical properties since they could not be completely regained after redrying the saturated specimens. Loss in mechanical properties is attributed to an increase in chain mobility in the presence of water. Under wet conditions, cellulose PP composites are better than glass fiber reinforced nylon composites (Figure 8).

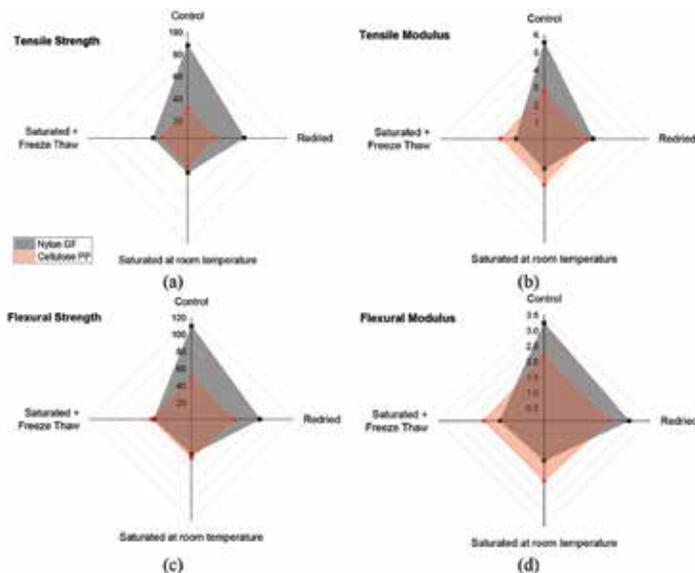


Figure 8 Comparison between hygrothermal effects on mechanical properties of glass fiber reinforced nylon composites and cellulose reinforced polypropylene composites

4.4. FIBER LENGTH DISTRIBUTION

The extraction of rice hull and wood fiber from the pellets show that the filler contents have been completely pulverized (Figure 9). The original size of both the fillers is 1-2 mm range before compounding. A separate study on the effect of Decalin on the filler at high temperature (150°C) and shear-induced by magnetic stirrer show no alteration on the particle size. The cause of pulverization observed in the pellets can be attributed to the high shearing caused during compounding. This suggests that the natural fillers may not be contributing much to the increment in the mechanical properties of the composites. Improvements in the mechanical properties of natural fiber composites can be achieved by optimizing the processing parameters during compounding.

Figure 10 shows short glass fibers (GFC) and long glass fibers (LGF) extracted by burning the polymers. The short glass fibers were extracted from pellets as received. The average length of GFC in the pellet form is 523 μm, whereas the original length of the fibers before compounding is 6 mm. Similarly, the average length of long glass fibers after the first cycle of injection molding is 706 μm, while the original length of LGF is 12 mm. Figure 11 and Figure 12 show that significant fiber attrition occurs after recycling and processing, which is the leading cause for the degradation in mechanical properties.

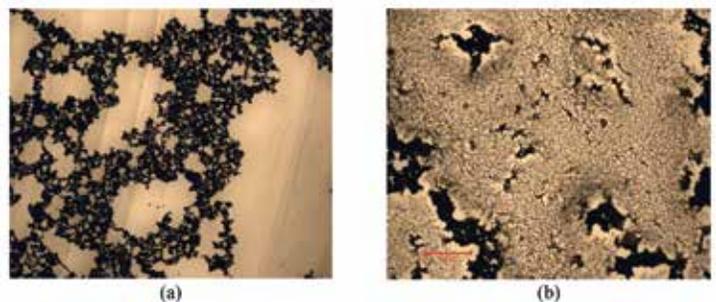


Figure 9 Optical microscope images of (a) rice hull and (b) wood fiber extracted from as received pellets after Decalin treatment



Figure 10 Optical microscope images of (a) short glass fibers and (b) long glass fibers extracted by burning as received pellets in an oven

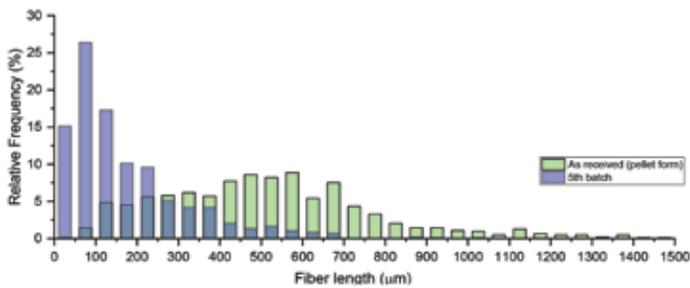


Figure 10 Optical microscope images of (a) short glass fibers and (b) long glass fibers extracted by burning as received pellets in an oven

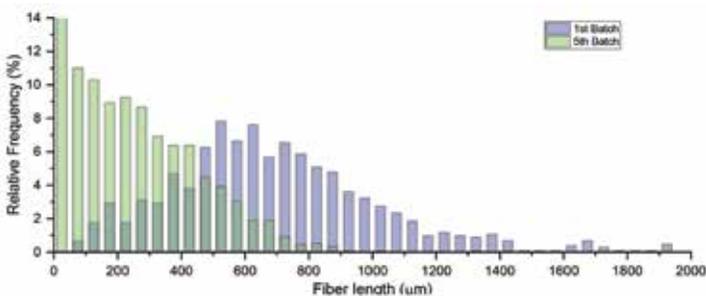


Figure 10 Optical microscope images of (a) short glass fibers and (b) long glass fibers extracted by burning as received pellets in an oven

5. CONCLUSIONS

Following are the conclusions drawn from this study:

- Effect of mechanical recycling (regrinding) on tensile, flexural, impact properties were studied on nine types of composites.
- Mechanical properties of natural fiber composites were not significantly affected by recycling retaining more than 90% of the original properties.
- Tensile and flexural strength properties of glass fiber reinforced composites were significantly affected by recycling retaining only 60–70% of the original values.
- Talc filled composites were unaffected by mechanical recycling.
- Impact properties of long glass fiber composite were also significantly affected, retaining only 39% of the original value after five batches of recycling.
- Only nylon composite was found to absorb water with 6.5% to 7.7% absorption at saturation.
- Cellulose composites were at par or better than nylon composites under wet conditions.
- Optical images of rice hull and wood fibers extracted from as received pellets show that the filler has been pulverized during the compounding process.
- Fiber length distribution of glass fibers shows significant attrition after mechanical recycling.

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